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General Technical
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OUR NATIONAL LANDSCAPE

A Conference on Applied Techniques for Analysis and Management of the Visual Resource

April 23-25, 1979, Incline Village, Nevada

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Proceedings of

OUR NATIONAL LANDSCAPE

A Conference on Applied Techniques for Analysis and Management of the Visual Resource

April 23-25, 1979, Incline Village, Nevada

TH 28

Gary H. Elsner Richard C. Smardon
Technical Coordinators

CONTENTS

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Page

Introduction

Opening Remarks, *by Robert Z. Callaham* 1
Conference Orientation for Our National Landscape: An Experiment in Creative Conference Programming, *by Richard C. Smardon, Gary H. Elsner, and George C. Coombes* 4
Conserving the Magnitude of Uselessness: A Philosophical Perspective, *by Alan Gussow* 6
Resource Policy and Esthetics: The Legal Landscape, *by M. Rupert Cutler* 12
Managing the Forest Landscape for Public Expectations, *by John R. McGuire* 16

Major Challenges in Landscape Planning: Simulated Field Trips

Surface Mining, *by Robert Leopold, Bruce Rowland, and Reed Stalder* 20
Visual Impacts in the Urban-Wildland Interface, *by Arthur W. Magill, Rowan A. Rowntree, and Robert O. Brush* 25
Simulated Field Trip on Ski Area Development, *by John J. Lindsay and Hubertus J. Mittmann* 31
Timber Management Simulated Field Trip, *by Ronald M. Walters, Warren R. Bacon, and Asa D. Twombly* 36
Highway Development, *by Peter M. Harvard and Bernard L. Chaplin* 44
The Countryside Visual Resource, *by Sally Schauman* 48
Linear Utility Corridors—A Simulated Visual Field Trip, *by Robert W. Ross, Jr.* 55
Range Management Visual Impacts, *by Bruce R. Brown and David Kissel* 58
A Simulated Field Trip: "The Visual Aspects of Power Plant Sitings," *by Bill Bottomly and Alex Young* 63
Dams and Water Developments, *by Robert H. Schueneman* 70
The Off-Road Recreation Vehicle—Visual Impacts, *by Stephen F. McCool* 73

Technology Available to Solve Landscape Problems

Descriptive Approaches to Landscape Analysis, *by R. Burton Litton, Jr.* 77
Computers and the Landscape, *by Gary H. Elsner* 88
Setting Technical Standards for Visual Assessment Procedures, *by Kenneth H. Craik and Nickolaus R. Feimer* 93

Pacific Southwest Forest and Range Experiment Station
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September 1979

Page

Technology Available to Solve Landscape Problems—Session A: Descriptive Approaches

Seeing Desert as Wilderness and as Landscape—An Exercise in Visual Thinking, *by John Opie* 101
Conducting a Wildland Visual Resources Inventory, *by James F. Palmer* 109
Visual Unit Analysis: A Descriptive Approach to Landscape Assessment, *by R. J. Tetlow and S. R. J. Sheppard* 117
Enviroplan—A Summary Methodology for Comprehensive Environmental Planning and Design, *by Robert Allen, Jr., George Nez, Fred Nicholson, and Larry Sutphin* 125
The Mt. Mitchell Scenery Assessment, *by Robert F. Scheele and Gary W. Johnson* 129
Landscape Maps as an Aid to Management of Scenic Mountain Areas, *by Roland Baumgartner* 136

Technology Available to Solve Landscape Problems—Session B: Computerized and Quantitative Approaches

Policy Capturing as a Method of Quantifying the Determinants of Landscape Preference, *by Dennis B. Propst* 142
A Computerized System for Portrayal of Landscape Alterations, *by A. E. Stevenson, J. A. Conley, and J. B. Carey* 151
Analysis of Landscape Character for Visual Resource Management, *by Paul F. Anderson* 157
Visual Absorption Capability, *by Lee Anderson, Jerry Mosier, and Geoffrey Chandler* 164
A Proposed Biophysical Approach to Visual Absorption Capability (VAC), *by W. C. Yeomans* 172
The Visual Information System, *by Merlyn J. Paulson* 182
Visual Management Support System, *by Lee Anderson, Jerry Mosier, and Geoffrey Chandler* 189
A Systematic Approach for Locating Optimum Sites, *by Angel Ramos and Isabel Otero* 196
The Use of VIEWIT and Perspective Plot to Assist in Determining the Landscape's Visual Absorption Capability, *by Wayne Tlusty* 201

Technology Available to Solve Landscape Problems—Session C: Psychometric and Social Science Approaches

Visual Resources and the Public: An Empirical Approach, *by Rachel Kaplan* 209
Measuring Familiarity for Natural Environments Through Visual Images, *by William E. Hammitt* 217
The Q-Sort Method: Use in Landscape Assessment Research and Landscape Planning, *by David G. Pitt and Ervin H. Zube* 227
Complexity and Valued Landscapes, *by Michael M. McCarthy* 235
Perception and Landscape: Conceptions and Misconceptions, *by Stephen Kaplan* 241
The Social Value of English Landscapes, *by Edmund C. Penning-Rowsell* 249
Dimensions of Landscape Preferences from Pairwise Comparisons, *by F. González Bernaldez and F. Parra* 256
Numerical Modeling of Eastern Connecticut's Visual Resources, *by Daniel L. Civco* 263
The Derivation of Scenic Utility Functions and Surfaces and Their Role in Landscape Management, *by John W. Hamilton, Gregory J. Buhyoff, and J. Douglas Wellman* 271
Visual Perception of Landscape: Sex and Personality Differences, *by A. Macia* 279

Page

Technology Available to Solve Landscape Problems—Session D: Evaluation of Visual Assessment Methods

Appraising the Reliability of Visual Impact Assessment Methods, *by Nickolaus R. Feimer, Kenneth H. Craik, Richard C. Smardon, and Stephen R.J. Sheppard* 286

Evaluation and Recommendations Concerning the Visual Resource Inventory and Evaluation Systems Used Within the Forest Service and the Bureau of Land Management, *by Blaise George Grden* 296

The Generation of Criteria for Selecting Analytical Tools for Landscape Management, *by Marilyn Duffey-Armstrong* 305

Appropriate Combinations of Technology for Solving Landscape Management Problems—Session E: Surface Mining and Reclamation

Texas Lignite and the Visual Resource: An Objective Approach to Visual Resource Evaluation and Management, *by Harlow C. Landphair* 312

Computer-Aided Visual Assessment in Mine Planning and Design, *by Michael A. Hatfield, J. LeRoy Balzer, and Roger E. Nelson* 323

Opportunities for Visual Resource Management in the Southern Appalachian Coal Basin, *by John W. Simpson* 328

Visual Analysis as a Design and Decision-Making Tool in the Development of a Quarry, *by Randall Boyd Fitzgerald* 335

A Case Study: Death Valley National Monument California-Nevada, *by Daniel Hamson and Toni Ristau* 340

Appropriate Combinations of Technology for Solving Landscape Management Problems—Session F: Urbanization; Highway Development

Assessing the Visual Resource and Visual Development Suitability Values in Metropolitanizing Landscapes, *by Charles B. Yuill and Spencer A. Joyner, Jr.* 348

Measuring the Impact of Urbanization on Scenic Quality: Land Use Change in the Northeast, *by Robert O. Brush and James F. Palmer* 358

A Comprehensive Approach to Visual Resource Management for Highway Agencies, *by William G. E. Blair, Larry Isaacson, and Grant R. Jones.* 365

Highway Attitudes and Levels of Roadside Maintenance, *by Gary D. Hampe and F. P. Noe* 373

A Method for Improved Visual Landscape Compatibility of Mobile Home Parks, *by Daniel R. Jones* 380

Appropriate Combinations of Technology for Solving Landscape Management Problems—Session G: Recreational Development

Does the Public Notice Visual Resource Problems on the Federal Estate?, *by John D. Peine* 401

Landscape Assessment for Tourism, *by Clare A. Gunn* 409

Assessment of Visual Resources Desirable for Tourism and Recreational Uses Along the Site of Lake Choon-Chon in Korea, *by Won-Woo Suh* 415

Projecting the Visual Carrying Capacity of Recreation Areas, *by Thomas J. Nieman and Jane L. Futrell* 420

Visual Resource Inventory and Imnaha Valley Study: Hells Canyon National Recreation Area, *by David H. Blau, Michael C. Bowie, and Frank Hunsaker* 428

The Use of Computer Graphics in the Visual Analysis of the Proposed Sunshine Ski Area Expansion, *by Mark Angelo* 439

Appropriate Combinations of Technology for Solving Landscape Management Problems—Session H: Rural and Agricultural Development

Managing for Naturalness in Wildland and Agricultural Landscapes, *by Joan Nassauer* 447

Visual Resources of the New Jersey Pine Barrens: Integrating Visual Resources into the Planning Process, *by John W. Sinton* 454

Toward a State Landscape Policy: Incremental Planning and Management in Vermont, *by Mark B. Lapping* 462

Appropriate Combinations of Technology for Solving Landscape Management Problems—Session I: Utility Corridors; Siting of Power Plants

Northwest Montana/North Idaho Transmission Corridor Study: A Computer-Assisted Corridor Location and Impact Evaluation Assessment, *by Timothy J. Murray, Daniel J. Bisenius, and Jay G. Marcotte* 470

Aesthetic Impact of a Proposed Power Plant on an Historic Wilderness Landscape, *by Carl H. Petrich* 477

Simulation of the Visual Effects of Power Plant Plumes, *by Evelyn F. Treiman, David B. Champion, Mona J. Wecksung, Glenn H. Moore, Andrew Ford, and Michael D. Williams* 485

Evolution of a Visual Impact Model to Evaluate Nuclear Plant Siting and Design Option, *by Brian A. Gray, John Ady, and Grant R. Jones* 491

Visual Sensitivity of River Recreation to Power Plants, *by David H. Blau and Michael C. Bowie* 499

Classification of the Visual Landscape for Transmission Planning, *by Curtis Miller, Nargis Jetha, and Rod MacDonald* 507

Appropriate Combinations of Technology for Solving Landscape Management Problems—Session J: Timber Management

Scenic Beauty Estimation Model: Predicting Perceived Beauty of Forest Landscapes, *by Terry C. Daniel and Herbert Schroeder* 514

The Semantic Differential in Landscape Research, *by H. E. Echelberger* 524

Identification of Scenically Preferred Forest Landscapes, *by Roberta C. Patey and Richard M. Evans* 532

Visual Management System and Timber Management Application, *by Warren R. Bacon and Asa D. (Bud) Twombly* 539

The Role of the Landscape Architect in Applied Forest Landscape Management: A Case Study on Process, *by Wayne Tlusty* 548

A System to Program Projects to Meet Visual Quality Objectives, *by Fred L. Henley and Frank L. Hunsaker* 557

Project Visual Analysis for the Allegheny National Forest, *by Gary W. Kell* 565

Appropriate Combinations of Technology for Solving Landscape Management Problems—Session K: Water Resource Development

Landscape Preference Assessment of Louisiana River Landscapes: a Methodological Study, *by Michael S. Lee* 572

Management of the Lower St. Croix Riverway: the Application of Cognitive Visual Mapping and Social and Resource Assessment Methods, *by Robert Becker, William Gates, and Bernard J. Niemann, Jr.* 581

A Visual Resource Management Study of Alternative Dams, Reservoirs and Highway and Transmission Line Corridors near Copper Creek, Washington, *by John Ady, Brian A. Gray, and Grant R. Jones* 590

Page

Predicting the Visual Quality Impacts of Development: A Simulation of Alternative Policies for Implementing the Massachusetts Scenic and Recreational Rivers Act, *by Carl Steinitz* 598
Combining Computer and Manual Overlays—Willamette River Greenway Study, *by Asa Hanamoto and Lucille Biesbroeck* 610
VIEWIT Uses on the Wild and Scenic Upper Missouri River, *by Dwight K. Araki* 618

Appropriate Combinations of Technology for Solving Landscape Management Problems—Session L: Outer Continental Shelf and Coastal Energy Development

Managing the Visual Effects of Outer Continental Shelf and Other Petroleum-Related Coastal Development, *by Philip A. Marcus and Ethan T. Smith* 627
Visual Simulation of Offshore Liquefied Natural Gas (LNG) Terminals in a Decision-Making Context, *by Brian E. Baird, Stephen R. J. Sheppard, and Richard C. Smardon* 636
Visual Impact Assessment in British Oil and Gas Developments, *by Dennis F. Gillespie and Brian D. Clark* 645
A Technique for the Assessment of the Visual Impact of Nearshore Confined Dredged Materials and Other Built Islands, *by Roy Mann* 654

Landscape Management Systems

The Visual Management System of the Forest Service, USDA, *by Warren R. Bacon* 660
The Bureau of Land Management and Visual Resource Management—An Overview, *by Robert W. Ross, Jr.* 666
Soil Conservation Service Landscape Resource Management, *by Sally Schauman and Carolyn Adams* 671

Legal and Policy Tools Available to Use in Solving Landscape Management Problems

Litigation and Landscape Esthetics, *by Michael McCloskey* 674
The Interface of Legal and Esthetic Considerations, *by Richard C. Smardon* 676
Landscape Values in Public Decisions, *by Richard N. L. Andrews* 686
Visual Quality Testimony in an Adversary Setting, *by Bruce H. Murray and Bernard J. Niemann, Jr.* 693

New Dimensions of Visual Landscape Assessment

Wildlands Management for Wildlife Viewing, *by Tamsie Cooper and William W. Shaw* 700
Potential Future Impacts on Visual Air Quality for Class I Areas, *by David Nochumson, Flavio Gurule, and Mona J. Wecksung* 706
Visual Resource Management of the Sea, *by Louis V. Mills, Jr.* 717
Designing Future Landscapes from Principles of Form and Function, *by Larry D. Harris and Patrick Kangas* 725
People, Planners and Policy: Is There an Interface?, *by Susan Kopka* 730

Future Direction for Research and Management

Human Habitat at the Fringe of the Forest: The Character of the Place, *by Richard L. Meier and William Ewald* 738
Research Needs for Our National Landscapes, *by Elwood L. Shafer* 744
The Energy Crisis and the American Landscape, *by Stuart Udall* 748

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We also thank all exhibitors who prepared poster sessions, or who supplied models, films, slide shows and other visual presentations. And special thanks go to the session moderators who did a skillful job in moderating sessions and reviewing session papers. These moderators, in order of appearance, include: Robert Z. Callaham, Edward H. Stone II, Jim Mertes, Edward C. Thor, Donald Appleyard, Carl Steinitz, Rachel Kaplan, Terry C. Daniel, Edwin R. Browning, J. Alan Wagar, Ronald W. Hodgson, Robert E. Leopold, David Davies, Herbert E. Echelberger, David W. Lime, and Jens Sorensen.

The bus tours of landscape planning projects were well-organized and conducted by Wayne D. Iverson and Glenn S. Smith, with the assistance of Jon Hoefer, Frank Magary, Daid Stoms, Katherine Snow, and Charles Lowrie.

This Conference could not have been possible without the generous support of the major sponsors and organizers: Forest Service, Soil Conservation Service, and Bureau of Land Management. Other cosponsors include: The American Society of Landscape Architects, Washington, D.C.; the Bonneville Power Administration, Department of Energy, Portland, Oregon; The Cooperative Extension, University of California, Berkeley; the Department of Landscape Architecture, University of California, Berkeley; the Federal Highway Administration, Department of Transportation, Washington, D.C.; the Geological Survey, RALI Program, Department of the Interior, Washington, D.C.; The International Union of Forestry Research Organizations, Vienna, Austria; the National Park Service; the Society of American Foresters, Bethesda, Maryland; the Surface Environment and Mining Program (SEAM), Forest Service; the Heritage Conservation and Recreation Service, Washington, D.C.; and the Tennessee Valley Authority, Norris, Tennessee.

Introduction

Opening Remarks[1]

Robert Z. Callaham[2]

Welcome to "Our National Landscape." The interest and enthusiasm surrounding the subject of landscape analysis is reflected by the expected registration of more than 500 persons at this conference. I trust that you will find these next few days stimulating and rewarding, both personally and professionally.

This conference comes at a time when the uniqueness and importance of landscape planning in land-use planning is receiving national and international recognition. This is shown by attendance at this conference of representatives from 13 other countries, from all parts of the United States, from all major land management agencies, from many universities, and from private companies, citizens' groups, and other organizations. We welcome your diverse viewpoints, your wealth of information and experience, and your desire to share and learn with us.

Among you are practicing landscape architects, environmental and recreational planners, professors, recreationists, industrialists, land and resource managers, researchers, and environmental consultants--just to name a few. You represent a good mix of those who generate and use landscape management technology.

Our special objective in bringing you together is to foster technology transfer--the utilization of available knowledge--about landscape planning for wildlands. I personally am working actively in methodology for technology transfer. My policy for the Pacific Southwest Forest and Range Experiment Station is that each meeting we sponsor will have multimedia outputs aimed at various needs and audiences--that is, practitioners, educators, extension agents, and researchers. For example, this meeting will result in far more than just the traditional, bulky proceedings, which too often rests unread in a bookcase.

From this conference the Eisenhower Consortium is producing a series of audio-visual outputs:

- Eleven slide-tapes of simulated field trips you'll see this afternoon
- Several slide-tapes portraying solutions to some of the problems depicted in the field trips, and
- Films to spread the messages presented at the opening and closing sessions.

Our Station is producing:

- Directories to everyone concerned with landscape. Indexed will be each individual's current activities, technical capabilities, and organizational affiliations;
- Executive awareness packages as aids to decisionmakers concerned with landscape patterns; and
- Bibliographies selected for relevance to typical problems facing practitioners.

As an aside, I have suggested that these selected bibliographies should be assembled in a new computerized data base called VIEWBASE, which would be parallel to two Forest Service data bases, called FIREBASE and PLANBASE, which now serve fire managers and land-use planners.

Let me put forth another suggestion aimed at improving future communications among you landscape planners. As a young scientist, I participated, with great personal benefit, in Western organizations which brought together the professionals concerned with forest genetics and tree breeding, and with forest insects and diseases. Other organizations exist to bring together line managers, soils specialists, and economists. Do landscape planners concerned primarily with wildlands need such an association as a forum for dialogue and interaction? Let's discuss the need and your options during this conference.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Director, Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Berkeley, Calif.

Some among you have recognized the need for a new periodical aimed at wildland landscape planners. It would provide practical information in a popular style. Is such a publication needed? Who might manage and produce it? Let me hear your feelings during this conference.

I hope from these remarks that you appreciate our strong desires about TT and KU--technology transfer and knowledge utilization. Our goal is to make this conference not an end in itself, but rather for it to be the starting point for new ventures to utilize knowledge about landscapes.

You were invited to the Lake Tahoe Basin--the site of this conference--because of both its strong visual appeal and its practical value in illustrating the modern pressures of population and development. People have drastically changed the visual character of this area. As a boy, some 40 years ago, I camped, swam and fished at this exact spot. The natural beauty of that primitive campground has since been replaced by this resort hotel and surrounding residences. This change is but one example of many innovative approaches toward sound environmental and visual planning to be found in this Basin. Here, in the Lake Tahoe Basin, a host of land-managment agencies, all levels of government, and private land-owners are interacting in order to coordinate planning and achieve mutual goals.

I know you will find this site an enjoyable and stimulating place to be. Spend some time looking around. Get a feel for the area. Examine the visual challenges. Analyze the design solutions that have been used here. The bus tour will do this for some of you on Thursday, but I urge you to explore the Basin on your own as well.

The Forest Service is pleased to join in sponsoring this conference--the largest, I understand, ever held on the topic. The breadth and depth of the program and participants are immense, particularly when compared with those at the first conference on landscape assessment at Amherst, Massachusetts, in 1973. Joining us as major sponsors is a sister agency in the Department of Agriculture, the Soil Conservation Service, represented by Sally Schauman, the acting head landscape architect. The third major sponsor is the Bureau of Land Management of the Department of the Interior, an agency with which the Forest Service may soon have a "subsumed" relationship, represented by William Duddleson, chief of the Office of Policy Analysis. Strongly supporting us in this endeavor are 12 cosponsors. Please look at the last pages of the pre-conference brochure and the inside back cover of the pre-conference abstracts for their names. All have contributed heavily, both in ideas, which are incorporated in the program, and in money and resources. Their generous support enabled us to make this meeting possible.

Let me now introduce some of the dedicated, talented people who helped put this conference together: Shirley Ramacher, of the University of California Forestry Extension, conference administrator; Lori Duncan, also of the university staff, the assistant conference administrator; Marcia Wood, with our Experiment Station, who is handling publicity; and Millie Otwell, who has been loaned to us by the Forest Service's Forest Environment Research Staff in Washington. I know you will join me in applauding what they have done to bring us to this point and what they will do to help you during the conference.

Our research station in Berkeley, California, includes a team having responsibility for national leadership in Forest Service landscape research. That team, led by your conference co-chairman--Dr. Gary H. Elsner --has played a major role in helping the National Forest System, Bureau of Land Management and other wildland management agencies protect and preserve our national landscape. Please feel free to contact this group--to exchange notes, or to discuss research priorities. As with all Forest Service research units, they are charged with serving all clients--whether public or private. As Director of the Experiment Station I'm extremely proud of the work they have done and the part they have played in organizing this conference.

I extend a special welcome to our visitors who have traveled here from other countries--including Australia, Canada, Indonesia, Israel, Korea, The Netherlands, New Zealand, Spain, Switzerland, Turkey, and the United Kingdom. Please introduce yourself to these visitors and help us make them feel welcome. We sincerely appreciate your involvement and interest. We look forward to hearing about the challenges of landscape planning in your homelands.

Some of you may be unfamiliar with the International Union of Forestry Research Organizations (IUFRO). The Forest Service is one of about 400 forestry research organizations in 90 countries that belong to IUFRO. IUFRO's Working Party on landscape planning meets here Wednesday afternoon. As a member of the Executive Board of IUFRO, I welcome members of the Working Party to this conference.

In closing, I would like to say that I'm sure you will find this to be a worthwhile conference. I hope it will...

- expand the intellectual horizons of landscape planning,
- facilitate real-world planning,
- encourage research to expand the technology for planning in the future, and
- provide you with a rewarding and memorable experience.

Conference Orientation for Our National Landscape: An Experiment in Creative Conference Programming[1]

Richard C. Smardon, Gary H. Elsner and George C. Coombes[2]

Abstract: This brief introductory paper discusses ideas behind the planning for the conference "Our National Landscape," the conference objectives and general flow of program events.

INTRODUCTION

The germination of our ideas concerning the programming, structure and content for this conference began 16 months ago. The idea of having the conference was earlier still, but the major portion of the program development thinking was done within those 16 months. This whole conference, although elaborately planned, was an experiment--from our perspectives at least.

The experiment was in the form of a test--a test of present approaches and facts for visual landscape assessment against present and near future visual impacts in wildland landscapes. The hypothesis to be tested was whether current approaches and methods could be successfully used in an "applied" way to deal effectively with current and near future visual management problems. If the hypothesis were proven false then future research and effort should be intensively redirected. If proven true then many current approaches should be utilized, e.g., technology transfer.

A good deal of effort was expended to develop unique presentation formats, especially the simulated visual field trips and the technology fair. The Eisenhower Consortium taped and filmed portions of the presentations for permanent record, and many of the presentations will be reused after having been shown at the conference. The conference is not a one time event. It will be recycled numerous times to facilitate technology transfer.

Another objective for having the conference--and no less important--was to have fun and to be stimulated by new ideas, formats and social interaction in a receptive environment. To accomplish this we tried to vary the format of presentation as much as possible without losing continuity.

To test the above stated objectives, we have asked you to help in critically evaluating the conference first, by inquiring if you found that the current proposed solutions to landscape management problems met management needs? If not, why? And secondly, by inquiring if the overall organization and individual sessions were stimulating and useful to you, considering both past conferences attended and in terms of this conference alone? Only by having critically evaluated conferences such as these will we be able to improve means of information transfer and asking the right questions.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Post Graduate Research Landscape Architect, Department of Landscape Architecture, University of California, Berkeley and Research Cooperator, Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.; Project Leader, Land Use and Landscape Planning Methodology Research Unit, Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.; Forestry Specialist with Cooperative Extension and Lecturer, Forestry and Resources Management, University of California, Berkeley.

MAJOR THEMES AND CHOREOGRAPHY

Four major substantive themes followed each other through the conference. The first theme was a description of major landscape management problems (needs). Second was a preview of new and improved landscape management approaches (tools) to deal with these needs. Third, we matched landscape management needs and tools via technology transfer, and fourth and last, some possible visual management futures were described as well as some of the implications for visual resource management.

The development of simulated visual field trips was a concept developed by the initial conference working group to bring the problem to us, rather than our going to the problem. By commissioning and coordinating a number of simulated visual field trips, we were able to span the breadth of many different technologies which impact upon many different landscapes in an extremely short period of time. These capsulated forays into the national landscape have the potential for giving us the kind of perspective on visual management problems that would not have been otherwise possible.

We then shifted perspective to review tools available to solve these problems. We reviewed descriptive, computerized and quantitative, and psychometric and social science approaches to landscape assessment. We also had a major session on legal and policy tools, which are often separated from the design professionals purview. This was an attempt to reinstate this critical interface.

To some extent, the general session on "technology available to solve landscape problems" was meant as an introduction to the detailed concurrent sessions following the same methodological themes introduced earlier. But, more importantly though, we looked for major bench marks from the general session speakers about where we are and where we need to be regarding landscape assessment methodology.

Concurrent sessions A through D illustrated the detailed development in methodology concerning descriptive, computerized and quantitative approaches, and psychometric and social science approaches. Another concurrent session on evaluation of landscape assessment methods was added as well to show how we could be critical in a positive sense about our own methodological development.

Concurrent sessions E through L illustrated the "appropriate combinations of technology for solving landscape management problems" by linking up with many of the impacting activity types shown in the simulated visual field trips. The objective at this point in the program was to try to ascertain whether we have the means to deal with the visual management problems described before. We did this by selecting the best available applications of methods to problem areas and involved a mix of academicians, agency people, and private practitioners. The moderators for these sessions were also chosen for their working knowledge of the activity type and/or the interrelations of the different "players" included.

On the third morning we shifted perspectives and oriented ourselves to possible future directions of landscape research and management. Meier and Ewald led us through some future scenarios in a California context, but with national implications. Other nationally known figures then addressed different perspectives to future management issues including private industry, agency research and management, and legislative responses.

Finally, for those who desired to get "anchored" back on the land in dealing with landscape management issues, we had the bus tour of key landscape planning projects in the Lake Tahoe Basin.

Other special features included the Technology Fair with its films and slide shows, displays of equipment and book displays. Poster sessions were held to allow one-on-one exchange of ideas and concepts. Two special sessions were included on "Visual Resource Management Systems," and "Legal and Policy Tools," and an informal discussion session on "New Dimensions in Landscape Assessment." The inclusion of these types of features in the conference was meant to be a fulfillment of our format objective of maximum variety of display modes.

Our anticipation was that participants in the conference would leave the conference with new and valuable bits of information and insights into the utility and validity of methods and techniques for visual landscape analysis and management. This anticipation has been fulfilled.

Conserving the Magnitude of Uselessness: A Philosophical Perspective[1]

Alan Gussow[2]

Abstract: The existential landscape is characterized. Distinctions are made between land and landscape, and between community and commodity. Human intervention based on symbiosis is praised. Extended discussion of scenic resources follows--definition; emphasis on landscape as stage not back-drop; value of humanized landscapes; role of deisgn; methods for determining quality; function of scenic resources; listing of suggested principles for protecting and managing visual landscape.

The winter 1965 issue of Landscape Magazine contained one of J.B. Jackson's usual provocative essays, this one titled, "Jefferson, Thoreau and After." In the final paragraph Jackson described what he then saw developing around us as an "existential landscape--without prototypes, devoted to change and mobility," adding, "it may have vitality but it is neither physically beautiful or socially just." Russell Baker, columnist for The New York Times, said pretty much the same thing, perhaps a bit more colloquially: "Has anybody else noticed that America is vanishing?" Baker went on to say that "people were no longer in places that could properly be called places, they were in suburban shopping centers and at television sets ... now a shopping center, of course, is no place, absolutely no place at all. There is only one shopping center in existance. Every American has been there, has smelled it. It moves around the continent at the speed of light. You find it at Wheaton, Md., and then--get on an airplane and fly like a bullet to escape the horror of it--and there it is waiting for you at Irving, Texas, or Falmouth, Mass. Maybe it isn't moving around the country at all. Maybe it truly is everywhere. Maybe America really is vanishing all right. Asphalt, stolidly menacing shelves of homogeneity marching off to a cement horizon; hot dogs and self-service, mass-produced people and neon, a market with no smells."

What kind of a landscape is this? Can we find any meaning in it? When Russell Baker says of the American landscape, "the place is vanishing all right," exactly what is he talking about? What is vanishing is diversity in the landscape we inhabit, diversity in the place where we live. What is vanishing is the capacity of the landscape to evoke memories, to provide us with the direct experience of spaces and proportions other than those of our own devising. What is vanishing is gentle use and respect for forms--living and non-living--which provide us with a sense of time and a sense of history. What is vanishing in the landscape are connections with our own sources--geological, biological and cultural.

To paraphrase Aldo Leopold (1966), land is a community, a biotic, self-renewing community. The landscape however has become a commodity. The American land was--and in many places remains--a diverse, rich, resonating environment, capable of stimulating our senses. The American landscape, however, has become a product. Buried, level-led, trampled, strip-mined, laid waste, channelized, gouged, eroded--the native American land has been pushed around and used, cut and filled, merchandized, bought and sold, and treated like so much raw material.

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What is happening, in fact, is that we are getting a national landscape, an often dreary, homogeneized, visually cluttered landscape, an impoverished landscape lacking all organic resonance. In some circles it is still fashionable to speak of visual resources as amenities, something agreeable but hardly essential. Yet the landscape is more than a passive backdrop. It is the stage on which we move. The events of life take place somewhere and that "whereness" affects the perception of the event. The visual landscape, the environment we see, gives shape to our character. The objects and forms in that landscape influence our actions, guide our choices, affect our values, restrict or enhance our freedom, determine where and with what quality we will mix with each other. The perceived landscape molds our dreams, locates our fantasies and in some mysterious way even predicts our future. We did not gather at the conference to talk about amenities, but to determine the highest and best use of our most maligned, ignored, unappreciated natural resource--the visual landscape.

Most people haven't begun to think of the visual resource as just that, a resource. I am reminded of the public's awareness, or lack of awareness, concerning air and water resources back in the pre-Earth Day period. Air and water were so omnipresent no one thought about them. They were free, available for use, unburdened by responsibilities. The concept of public values was yet to be expressed. I think this is precisely where we are now in our thinking about visual resources.

The conference was on "Applied Techniques for Analysis and Management of the Visual Resource." The conference planners developed a long list of visual resource management problems, including such concerns as surface mining and reclamation, urbanization, utility corridors, highway development, siting of power plants and much, much more. Is it possible that we gathered to perform an autopsy on a dying landscape and that the only issue remaining to debate is which of these management problems killed the patient?

Yet, perhaps Pogo the possum said it best, "We are surrounded by insurmountable opportunities!" Conventional wisdom depicts man as spoiler, a rapist of the environment. The story line is familiar: where man goes, pollution is sure to follow. We consume finite resources, we abuse the environment, we degrade and destroy our living habitat. Nature would be better off left alone.

But would our land and our landscape be better off left alone? Is every intervention automatically destructive of quality? While I agree with David Brower (Leydet and Rose 1969) that--"Wildness made man, but he cannot make it. He can only spare it." I also believe that we gathered to deal with more than wildness. More importantly, I am convinced that it is possible to design a landscape which is beautiful, sustainable and life enhancing. Human intervention need not always be depletive of landscape quality. Rene Dubos (1976) once said, "Nature is like a great river of materials and forces that can be directed in this or that channel by human intervention. Such intervention is justified because natural channels are not neccessarily the most desirable, either for the human species or for other species. It is not true [he went on] that nature knows best. It often creates ecosystems that are inefficient, wasteful and destructive. By using reason and knowledge we can manipulate the raw stuff of nature and shape it into ecosystems that have qualities not found in wilderness. Many potentialities of the earth become manifest only when they have been brought out by human imagination and toil." Dubos' conclusion is a plea for a true symbiosis, "the word used in its strong biological sense to mean a relationship of mutualism so intimate that the two components of the system undergo modifications beneficial to both."

Dubos' observations should not, however, be read as a green light to intervene everywhere. As thoughful, appreciative professionals, your first responsibility is not to design strategies for the restructuring of the visual environment. More important, and the necessary first step, is to put a value on what already exists. This is particularly important when relatively natural environments are threatened by proposed actions. The first presemption should be to identify quality where quality exists, not to mitigate or arbitrate changes. Landscape modifications should be viewed only as a means, never as a goal. David Brower's dictum about "sparing" should not be dismissed too easily.

The process of intervention, then, begins when we take stock of what we have, when we look at the landscape and try to appreciate what is there. Intervention does not begin with management strategies; it begins by looking.

What is a scenic resource? Who decides that a location has quality and on what basis? Of what value is a scenic resource? If an area is thought worthy of protection or preservation, what is the best way of doing this? Will the beauty of the scenic resource be harmed by additions or modifications? I use the term "scenic resource" rather than visual resource to underscore the concept of quality but, as you will see, much of what I have to say applies equally to the visual resource.

Defining the term scenic resources is not easy. When confronted with the idea of scenic resources many people, focusing on the word scenic, avoid a definition, noting that we all know what is scenic and what is not at some intuitive level and that a landscape is scenic when it appears beautiful and natural. The word scenic suggests a view or vista, a viewpoint. So used, a scene becomes mere background. Even if we were to agree with what I would describe as a proscenium theory of scenery, that is, a scene is a view from a fixed point and therefore preselected, limited and controlled, would it be possible or even desirable to limit our appreciation of scenic resources to a series of vista points from which the public could enjoy fixed, limited scenes and ignore all those parts of the landscape that are not visible from those points?

To think of scenic resources in such static terms is to blunt the value and to underestimate the contribution that scenic resources make and might continue to make to all of our lives. A scenic resource is first and foremost a resource, something capable of use. That any resource may be degraded, exploited or badly used, there can be little doubt. This is as true of scenic resources as of, say, mineral or water resources.

To gain a perspective on the concept of scenic resources, we must first jettison the idea that a scenic resource is merely a view or even a series of views. A scenic resource is the landscape we see, all of it, not merely some predigested, pre-selected, pre-arranged, arbitrarily focused view. The essential understanding is that a scene is something we are a part of, to which we relate, not as spectators to a play but as participants in the events. The sights and smells, the sounds and textures, the shapes and proportions of the physical world we live in determine who we are and what we will become. In one way or another we may look at a scene but we live in the landscape. So it is that the entire landscape is the scenic resource, not isolated parts of it. If we accept this definition of scenic resources as the landscape we see and inhabit, then the need to protect and preserve that resource becomes central to our lives, not peripheral.

Rene Dubos (1976) notes that scenic resources or satisfactory landscapes are of two types, "wilderness still undisturbed by human intervention," and "various humanized environments created to fit the physiological, esthetic and emotional needs of modern, human life." Arguing that we need both kinds of landscapes, for different reasons, Dubos suggests that wilderness, apart from maintaining essential ecosystems, also satisfies the human need "to reestablish contact now and then...with biological origins, a sense of community with the past and with the rest of creation." As a realist, however, Dubos is also aware that most people spend most of their lives in what he calls "humanized nature...landscapes that have been transformed in such a way that there exists a harmonious interplay between human nature and environmental forces, resulting in adaptive fitness." One way to view the scenic landscape, then, is as an arena of adaptation, a place meant to be alive and changing.

Yet, by defining scenic resources so broadly we run the risk of losing the meaning of "scenic" altogether, for it is important to retain a sense of quality. The richness of detail, scale, color, variety and proportion, all the intrinsic visual components of the forms which surround us, affect us deeply. It is not sufficient to say that a scenic resource is the perceived landscape--the world we see and inhabit--and say no more. The work "scenic" invokes the notion of quality. Burt Litton (1976), in a brilliant analysis of shore-edge types, concluded that "while a landscape inventory has significant connections with both geological and vegetation surveys, aesthetic qualities are not revealed directly through scientific information but rather emerge from analysis of design relationships."

The key word is "design"--the shaping, assembling, pruning and selecting of parts of the world. We measure the success or failure of design by perceiving how our senses respond to physical objects. There is no scientific way to determine whether something is well-designed and hence beautiful. We must depend, as Litton notes, "on perception through the senses, with reaction and appraisal and awareness characterizing the process...judgment is involved."

Any effort at singling out views on the basis of comparative numerical values assigned to their component features will be counterproductive. This emerges clearly from Litton's further observation that, "it would ruin the character of the environment if, from adopting a quantified evaluation, we protected only those scenic areas which had the distinction of high values. Or what if the quantified landscape values merely represented median values? In accordance with the aesthetic criterion of unity, as much of the landscape's beauty is vested in its overall integrity--its connective fabric--as in its nodes of distinction. Neither can we take a static view that whatever we designate now as highly valuable may necessarily serve the value of a future time. I am convinced that an acceptable quantified system of scenic evaluations will be a very long time coming, if ever, and that then we should expect it to apply only to the most restricted segments of our total landscape. Maintenance of the landscape's overall integrity...is the fundamental goal."

How can we determine the quality of a scenic resource? On a functional level an object is well-designed if it is durable, well-made and works efficiently and economically--the knife which cuts cleanly, the sturdy engine which does its job well, the house that hoards heat in winter and permits cooling air to flow in summer. Yet even as we demand functional integrity, we also crave forms which are sensually pleasing. There is a further value in the knife which feels good in our hands, in the engine which satisfies our ears and the house which pleases our eyes.

We place many functional demands as well on the landscape in which we live. We expect it to accomodate houses, stores, places of employment, amusement and instruction--and easy ways of getting from one to the other. We require clean air and pure water. Yet beyond all these, we look to the landscape to supply an added, aesthetic dimension, to enrich human experience. What specifically this aesthetic dimension is varies for each of us. We are a diverse people. Some may find the greatest satisfaction in spacious views, others in the richness of architectural detail. Some may seek out hidden glades while others find greater visual reward in the pop counterpoint of the urban landscape. Rather than attempting to quantify scenic values in the abstract, we should seek some guiding principles in our efforts to find ways to protect and to manage our scenic resources.

Let me suggest three principles. First, we must find ways to maintain the landscape's overall integrity. Secondly, we must allow the landscape to continue as an arena of adaptation, that is, to change, to express new values and emerging tastes. Finally, we must take the responsibility to identify those "nodes of distinction" which warrant special protection. These three principles are far from being mutually exclusive. A landscape, like an object, has integrity if it has character, a kind of soundness. A scenic resource has integrity if the things of which it is composed fit together well. When it is impaired, a visual landscape loses some integrity. Impairment, however, should not be confused with variety. Almost all landscapes are, to a greater or lesser extent, resilient. We should welcome the sensual stimulation of varied forms and textures, the interplay of human and natural order. The fitness of a scenic resource does not require monotony or the exclusion of variety.

On what basis can we decide that something does or does not fit into the landscape? Can we declare with certainty that a specific addition to the landscape would impair its value as a scenic resource? Those things fit best into the landscape which enhance its coherance, render the landscape comprehensible, contribute to order and add to a sense of harmony. We not only know that the result is good but feel it as well, for the landscape of integrity calls forth good associations.

There are no quantitative criteria for producing or identifying such a landscape, only qualitative measures requiring judgment and experience. The best landscapes may be totally wild or wholly manmade. They may be physically expansive and overwhelming or they may be intimate and hermetic. There are no rules. The very notion of scenery is cultural and temporal. Different people in different times would make different choices.

How do we keep alive the integrity of the existing landscapes while at the same time permitting them to fulfill their adaptive role? How do we preseve the best of the past, the quality (where we find it) in the present and permit additions and changes which reflect new energies and new, creative, adaptive capacities? The answer lies in understanding and appreciating what already exists. The more we can discern the intrinsic character of any scenic resource, the more we will be able to make appropriate design and management decisions. Certainly the first step is to isolate and identify those nodes of distinction, those parts of the American landscape which are scenically unique and which have a clear national value. The landscape is not equal in quality in all places. Yet a scenic potential exists in many areas which, in the past, we have ignored--tall grass prairies, pine barrens, the big thicket of Texas, to name a few. No portion of the visual resource should be immune to reasonable scenic and preservation standards. Proposed projects should not be considered against a background of abstractly imposed criteria, however. Projects must always be evaluated in a specific context. Manmade structures are not intrinsic polluters of the visual environment. Not all manmade forms are misfits. Every addition to the visual landscape does not constitute impairment. The essential question about proposed projects is where will the project be located. Every proposed action must be considered in relation to the specific place and region where it would be placed, recognizing that some landscapes are more resilient and more capable of absorbing gross, manmade forms than other landscapes.

We must approach the landscape with an ecological viewpoint, what Paul Shepard (1969) has described as "a vision across boundaries." Shepard says of ecological thinking that "the epidermis of the skin is ecologically like a forest soil, not a shell, so much as a delicate interpenetration...revealing the self ennobled and extended rather than threatened as part of the landscape and the ecosystem because beauty and complexity of nature are continuous with ourselves." It is what the poet Conrad Aiken (1955) had in mind when he wrote:

The landscape and the language
  are the same
For we ourselves are landscape
  and are land.

We are not separate from our landscape. The landscape which surrounds us is a record of our behavior. It is an expresssion of our values. It is not simply visual resources which we manage; it is, rather, something in ourselves which we attempt to manage. The evolving landscape is a visual statement of who we are as a nation. When we endanger the landscape, therefore, it is a part of ourselves which we threaten.

I would like to conclude on a personal note. Most of you probably know that America's premier mountain climber, Willi Unsoeld, died recently in an accident on Mount Rainer. As one of two Americans to pioneer successfully a new and difficult route along the west ridge of Mount Everest, Willi Unsoeld was as much a humanist as a mountain climber.

I met Unsoeld only once, in October 1977, in the comfortable Carmel, California, living room of photographer Ansel Adams where, along with a few others, we had been assembled by the National Park Service to discuss "visibility as a value."

Sitting quietly in a big arm chair, Willi Unsoeld spoke that morning about human values, saying, "When I stand at the rim of the Grand Canyon I ask: what is the value involved here to a human being? I'm not satisfied that it is just a pretty view. To me it comes down to the question of what we are after in ths world. For my money it's how we treat each other as human beings. A factor is the image we carry with us of how we relate to the world around us. Nowadays, because of the enormous power scientists have rendered us, we feel in charge. We control things." Then Willi Unsoeld ended his thoughts by saying, "The view of the sweep and stretch of space is a corrective to our abounding pride in our own capability. We have the experience for a moment of being reduced in size to the real scale we inhabit on this earth."

I can only assume that it was honest, open joy, in the world of nature, not concern for the abstract idea of visual resources, which set in motion the chain of life's events which brought each of you to the conference. As you explore ways of applying techniques for analysis and management of the visual resource, I urge each of you to do two things: remember always the profoundly satisfying, spiritually uplifting, beautiful places you, yourself, have seen. And lastly, recalling Willi Unsoeld's words, never forget your true scale on this earth.

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Resource Policy and Esthetics: The Legal Landscape[1]

M. Rupert Cutler[2]

Few have expressed man's relationship to the landscape as well as Aldo Leopold did in "A Sand County Almanac." The one-time Forest Service administrator and professor of wildlife management wrote: "We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect. There is no other way for land to survive the impact of mechanized man, nor for us to reap from it the esthetic harvest it is capable, under science, of contributing to culture."

To me, that pearl of wisdom expresses the fundamental purpose of this conference--the coming together of individuals with diverse resource backgrounds to share views and find new ways of reaping the esthetic harvest of the land, and still provide, within reason, the resources that drive our modern, mechanized lives.

Landscape management has found and established its place in resource management, at least on the federal lands. Many of the rules and policy directions are still evolving, but the foundation has been set. Today, I'd like to review a few of the statute-based policies and legal precedents that cement this foundation.

A fundamental change has occurred in the way natural resources policy is made. An additional set of key actors now is involved in the policy process. Judge James M. Burns of the U.S. District Court in Oregon, has described the phenomenon this way: "The last 20 to 25 years or so have produced a significant, though largely silent, transfer or reallocation of power (perhaps a virtual revolution would not be too strong a word) in our society, a transfer of power from the executive and legislative to the judiciary. I suspect that the public generally is unaware of the fact that a good many, if not most, of the significant social, economic, and environmental decisions are now made by judges rather than by governmental officials who are directly responsive, in an electoral sense, to the public."

This changing role of the courts was stated even more explicitly by law processors Richard B. Stewart of Harvard and James E. Krier of Stanford, in their book Environmental Law and Policy. They characterize the attitude which prevailed in the late 1930's this way: "Social and economic problems could best be solved by giving free rein to the expert wisdom of agency officials." But that has changed, and they conclude that: "Recently, however, there has been considerable disillusion with the notion of 'expertise' as a solvent of difficult social and economic problems. Regulatory issues are increasingly seen as invoking choices among competing social and economic interests and values that cannot be resolved on technical grounds."

In the case of esthetics, this means that as more laws are passed requiring agencies to consider esthetics in decisionmaking, the public also has more access to the courts to seek redress on those decisions. And courts over the last 10 years have shown more willingness to grant redress than in previous years.

I hope I won't steal too much of Rick Smardon's thunder by quoting from his report with the delightful title, "Law and Aesthetics or When is the Pig in the Parlor?" He describes the judicial role this way: "There has been a gradual shift of the courts' desires and abilities to face issues with environmental esthetic values. This shift evolves from not facing it to fictionalizing or masking esthetics under other issues, to facing up to the procedural rights to address esthetic injury."

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Let's review now some of the Federal statutes which create a duty to consider esthetics in resource management. In seeking to "encourage productive and enjoyable harmony between man and his environment," the National Environmental Policy Act of 1969 (NEPA) specifically addressed "esthetics" as a segment of environmental quality. Of the six goals set forth for the Nation by the NEPA, one is to "assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings."

NEPA requires all Federal agencies to "utilize a systematic, inter-disciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on man's environment."

Note that NEPA's intent was not necessarily to preserve, but to put man and nature in productive harmony. The law even requires that each member of the Council on Environmental Quality "be conscious of and responsive to the scientific, economic, social, esthetic, and cultural needs and interests of the Nation"

Even before NEPA, other laws dealt with esthetics for particular classifications of land. The Wilderness Act of 1964 is an example. Yet, I caution that wilderness never should be thought of solely in terms of esthetics or scenic and recreational values. Its scientific, educational, ecosystem conservation, and historical site-preservation values are just as important. Likewise, as the community of plants and animals in a wilderness changes over time, some people may not consider it as esthetically pleasing as a visually managed landscape. Others will consider it superior to a managed landscape, of course!

The National Wild and Scenic Rivers Act and the National Trails Act--both vintage 1968 laws--are intended to protect scenic values. So is the 1972 Coastal Zone Management Act, though it goes a bit further by encouraging States to manage coastal zones for "full consideration to ecological, cultural, historical and esthetic values as well as needs for economic development." Again we see a congressional mandate to manage resources for "productive harmony" between homo sapiens and the rest of nature.

That mandate was extended even further when the Endangered Species Act recognized wildlife as an extremely important component of the visual resource. The law cites the "esthetic, ecological, education, historical, recreational, and scientific value" of these species "to the Nation and its people."

From these specific applications of esthetics, we moved to more all-encompassing authorizations. For instance, the Federal Land Policy and Management Act of 1976 declares right up front that "the public lands shall be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values as well as provide commodity resources.

The visual resource is emphasized implicitly throughout the National Forest Management Act of 1976, and explicitly in the regulations which are being developed under Section 6 of that law.

Chief McGuire and I are personally interested in protecting the visual resource, and our concern will be reflected in the forthcoming National Forest Management Act regulations. It will be particularly evident in Section 219.12 of the regulations, which provides criteria for forest planning. Specific language requiring consideration of esthetic values occurs in both the timber and recreation segments of this section of the "regs."

All National Forest land use planning will be done by interdisciplinary teams--and those teams will include landscape architects. That's not new, really; the Forest Service has included landscape architects on such planning teams for some time now.

Partly as a result of these laws, a whole new sub-discipline of the legal profession has emerged--that of environmental law. In a real sense, it's still in the pioneering stages--and neither the lawyer nor the resource manager, the judge nor the legislator, can confidently predict where it will lead. I can only say that it has certainly influenced every level of decisionmaking in the Federal government--and, in my opinion, for the better.

It was 25 years ago, in a case called Berman v. Parker that the Supreme Court said: "The concept of the public welfare is broad and inclusive. The values it represents are spiritual as well as physical, esthetic as well as monetary. It is within the power of the legislature to determine that the community should be beautiful as well as healthy." The question at hand was whether, under the District of Columbia Redevelopment Act of 1945, a building could be condemned because it did not fit esthetically with the area's redevelopment. The court said yes.

Even though the ruling was for esthetics, the case came to court because the building's owner complained of monetary injury. Until recently, Federal courts would hear cases concerning environmental quality and esthetics only if an individual could prove injury in the traditional sense--to his person, property, or pocketbook. Then in 1970, a landmark case --not concerning natural resources--extended the limits of judicial review. This meant that the Federal Courts could hear suits from those claiming "injury in fact," including injury of a more spiritual nature.

Since then, we've seen more and more suits, such as the one in which the West Virginia Highlands Conservancy successfully sued the Island Creek Coal Company, claiming injury to "esthetic, conservational, or recreational interests." I might add that the Conservancy's right to sue still hinged on direct injury to its individual members, who used the area extensively. What about general injury to society--and future generations--that may occur when esthetic values or the environment itself are damaged? This issue has been the focus of several legal battles. The notion that the environment itself has rights has been seriously advanced.

Christopher D. Stone, Professor of Law at the University of Southern California, argued this belief eloquently and convincingly in his essay, "Should Trees Have Standing? Toward Legal Rights for Natural Objects." He wrote: "It is not inevitable, nor is it wise, that natural objects should have no rights to seek redress in their own behalf. It is no answer to say that streams and forests cannot have standing because streams and forests cannot speak. Corporations cannot speak either; nor can states, estates, infants, incompetents, municipalities, or universities. Lawyers speak for them."

Justice William O. Douglas made a similar plea in a dissenting vote when the Supreme Court ruled that the Sierra Club--as a club and without reference to individualized injury --lacked standing to sue to prevent construction of a resort in Mineral King Valley of the Sequoia National Forest. He said: "The voice of the inanimate object...should not be stilled... . Before these priceless bits of Amercana (such as a valley, an alpine meadow, a river, or a lake) are forever lost or are so transformed as to be reduced to the eventual rubble of our urban environment, the voice of the existing beneficiaries of these environmental wonders should be heard."

But the Supreme Court decision clearly upheld the opposite view, that trees do not have standing and suits cannot be heard in their behalf. This remains the law of the land.

So here we stand. We have a foundation of legislative and judicial rulings. Yet we're still short of all the leverage we'd like to have to protect esthetic values. Some of the statutory language is vague. Some of the Court decisions seem to contradict each other. In short, administrators almost have to read between the lines for policy direction. At least, this is how I see the position of those who manage the Federal lands. President Carter's May 1977 environmental message was one of several initiatives taken by this Administration to indicate strong support for interpretations of statutory and case law which give esthetic value protection the benefit of the doubt.

At the same time, we're seeing a trend toward recognizing public rights on private lands. Massachusetts law has always granted public access to great ponds, over so many acres in size, even on private lands. This idea came from England, where traditional walking trails have been considered public for years, even when they cross a farmer's field. Modern applications include zoning to protect agricultural lands, coastal shorelines, and free-flowing, undeveloped river corridors.

One essential fact rings loud and clear: "The voice of the existing beneficiaries of these environmental wonders" is being heard in more and more ways. If the public voice had been silent, Congress would never have given us the legislation recognizing environmental and esthetic concerns. Nor would the courts have tempered their rulings with concern for the public interest.

The executive agencies also have been listening to that voice. It's increasingly easy to hear. The difficulty is that we hear two messages. People want esthetics and environmental concerns to play a key role in resource decisions. But they also want a continuous--and usually expanding--supply of commodities from these resources. How do we respond simultaneously to both these messages embodying the "public interest?"

Part of the answer will, I hope, be provided during this conference. The public often does not object to resource development if we can create an acceptable landscape while extractive use is occurring or shortly there--after.

While the courts are expanding opportunities for redress against agencies, this does not mean that the judicial route is the best one for concerned citizens to take. In fact, because of the cost, time, and crowded court dockets, it should be the last resort. Litigation is the acknowledgement that the other avenues of compromise and consensus--that is, administrative remedies--have either been explored or closed.

But if an agency can create a process that presents the facts and options honestly and openly to the people, and allows as many public voices as possible to be heard, and provides for meaningful responsiveness to public suggestions, this can prevent many court cases. In my opinion, it is the superior route--and can lead to decisions that are in the best interest of the public and resource, and therefore the agency itself.

This was exactly my intention with the second Roadless Area Review and Evaluation--RARE II. I agree with Professor Ian McHarg's process of landscape planning and management, and the RARE II process followed his approach of inventorying and planning for the most fragile areas first. I felt it was necessary to settle the question of which areas were important enough in their undeveloped state to be designated wilderness, also considering the economic trade-offs involved. Then, and only then, could we successfully plan and carry out developmental management of the balance of the roadless areas without facing litigation.

Last week, the Carter Administration's recommendation on RARE II were released. Almost 15½ million acres were proposed for wilderness status, 36 million for other so-called multiple uses, and about 10½ million for further planning. I believe these recommendations offer a balanced allocation to all uses. I also believe that, even though some interests would have favored a different mix, or a different decision on a particular area, the controversy will be far less under RARE II than if each area had been considered separately over a period of many years. The comprehensive RARE II process dramatizes how the Forest Service's multiple-use mandate provides "many uses" on National Forest System lands... something for almost everyone, within a region if not within a Forest. I might mention that the Wilderness Attribute Rating System used to help evaluate the roadless areas included esthetic considerations.

I'd like to point out that the Department of Agriculture's concern with landscape management goes beyond Federal lands. For example our Soil Conservation Service assists private owners, States and local communities in planning for and protecting natural resources. Specific assistance in land use decisions may involve soil surveys or the mapping of important agricultural lands. The assistance also may range from helping protect natural watercourses to working with schools to set up outdoor classrooms. Let me assure you the planning of all major SCS soil, water, and flood prevention projects incude giving specific attention to protecting visual and esthetic resources.

And now that our Science and Education Administration's Federal extension unit has a separate natural resources program, we will be able to do more to educate private citizens about visual management needs on all lands through the work of specialists associated with State Cooperative Extension Services.

Although I've stressed that statutory and case law which underlies the present Federal posture on visual resources, there are equivalent foundations in many States. I am personally familiar, for example, with Michigan's Environmental Protection Act, and know that California has a strong law of this kind. Finding ways to provide for the visual resource, as well as to supply food and fiber, is not just a Federal concern. It's an emerging area in which we're all struggling for authority and direction--both legislatively and judicially--to find better ways of getting the job done.

But what path do we follow now? I think Aldo Leopold's wisdom can again prevail. When talking about shifting to a conservation ethic, he said: "Perhaps such a shift of values can be achieved by reappraising things unnatural, tame, and confined in terms of things natural, wild, and free." In my opinion, this is precisely what you are trying to do at this Conference, and what the people of this country are striving for if they are truly concerned with natural resources conservation and with human well-being. Neither people nor the resources can be at peace and productive, until harmony is achieved between the two.

Managing the Forest Landscape for Public Expectations[1]

John R. McGuire[2]

Abstract: Since the founding of the Forest Service in 1905, public expectations have shifted from expectations of quantity, to expectations of quality in forest resources. The Forest Service program emphasis has been broadened to multiple use, including heavy recreational use and other pressures. Forest practices to accommodate use pressures may affect the quality of the forest landscape. But the visual resource can be managed in integration with other resources to make these practices visually acceptable to the public.

INTRODUCTION

By the standards of American public institutions, the Forest Service must be considered an old agency. This next year, we will celebrate our 75th anniversary and the history of forestry in the government goes back even further.

There have been some very significant changes since our founding. The nation, its people, and their needs and expectations are far different now. And the Forest Service of 1979 is markedly different from the Forest Service of 1905. Despite our age in years, I hope we are yet young, kept supple by the fresh challenges and new tasks given us by the evolving desires and expectations of the public we serve.

Today, those desires and expectations for our forest lands are greater and much more diverse than at any time in history. The National Forests, for example, were first administered for the legislatively narrow purpose of "securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of the citizens of the United States."[3] Those were the needs of a developing nation at the time, and the expectations of its people.

Yet our nation has changed markedly since 1905, and so has our use of the forests. Population has tripled. We have gone through an extensive and rapid urbanization. Transportation, communication, and energy consumption have increased at a pace unparalleled in history. And there now exists a sophisticated public which is more mobile, more affluent, and which has more leisure time at its disposal.

This is a public which views the forest with a perspective much different than that of the past generations, and which brings to the use of these forest lands a much broader and much more intense set of desires and expectations. Raymond Dasmann has described this change. In 1966 he wrote:

> Today a new wave of interest in conservation is sweeping across America, bringing new challenges to all who have been professionally engaged in conservation work. In the old conservation movement we were concerned with questions of quantity of natural resources--with saving enough forest land, with producing enough wildlife, with keeping

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Chief, Forest Service, U.S. Department of Agriculture, Washington D.C.

[3] Organic Administration Act 1897 (16 U.S.C. 475).

> our farms yielding enough food to meet our needs. These old conservation problems have not entirely been solved, although we have made great progress. The new conservation, however, is concerned not so much with quantity as with the quality of the human environment...Questions of clean air, clean water, open space, and facilities for outdoor recreation for the great masses of city people are emphasized in the new conservation drive.

In the management of the National Forests, the Forest Service continually copes with this change described by Dasmann--this attitude change--though not without occasional trauma. We have worked to broaden our programs and policies, to increase land productivity, and to make these lands increasingly available for the varied use and enjoyment of a greater proportion of the American people.

Since 1924, when the Forest Service designated the first wilderness area--the Gila Wilderness in New Mexico, we have, for example, increased our programs in fish and wildlife management, and in developed recreation, minerals, and watershed management to meet broadening public expectations.

In 1960, this broadened emphasis was given legislative endorsement by the Multiple Use-Sustained Yield Act,[4] which declared as policy, "that the national forests are established and shall be administered for outdoor recreation, range, timber, watershed, and fish purposes." And our programs have since been given additional legislative mandates for environmental quality, wilderness management, and management of the visual resource.

By the public's mandate as well as that of the Congress, the Forest Service today has program responsibilities across a broad spectrum of land uses ranging from production of commodities such as timber, water, minerals, and services such as developed recreation, to less tangible spiritual and esthetic values, such as wilderness. By every analysis, demands for each one of these forest land uses are increasing. Through the year 2030, for example, we have projected a 63 per cent growth in land-based recreation, a 116 per cent increase in the demand for timber, a doubling of demand for range-grazing, an 80 per cent increase in consumptive use of water, and substantial increases in the demand for minerals, as well as for fish and wildlife (U.S. Department of Agriculture, Forest Service 1979).

The National Forests and other public lands are already accommodating heavy uses of their many resources, and the pressure for additional resource products and values is certainly going to increase.

And through the keen observations of an articulate public, people have discovered that almost everything which land managers do on the land to accommodate these resource demands will alter, for better or for worse, the character of the forest landscape.

Our National Forest lands are public lands and as such, are subject to extensive first-hand attention from the public. Last year, for example, the Forest Service hosted the equivalent of 218 million people each spending a full day on the National Forests and Grasslands. That recreational use of National Forest System lands is more than that provided by any other Federal agency (U.S. Department of the Interior, HCRS 1977).

But much of this recreation use takes place in the midst of a great many other land uses, since these National Forests are multiple-use lands. Thus the recreating public usually has the opportunity to view the impact of a timber harvesting operation, forest road construction, mining or other extraction activity, power-line rights-of-way, or other land use or management practice upon the forest landscape.

Though scientifically and otherwise environmentally correct, many of our forest management practices or permitted land uses do not always produce landscapes which are visually acceptable to a public which is much more interested than ever before in the quality of the visual forest resource.

The public is willing to travel great distances and bear great inconvenience to view scenic vistas. Automobiles and tour buses are often bumper-to-bumper on the back roads of New England or on Skyline Drive of the Shenandoah National Park, for example, when the fall colors are at their peak.

And many of these people bring their own expections as to what the public lands should look like--expectations of "naturalness," of scenic landscapes, and of well-tended forests. And they may be sorely disappointed if those expectations are not realized because of the impacts of other land uses or land management practices.

I believe that the public also values publicly owned forest lands as a legacy to future generations, or as a measure of our culture.

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[4] 16 U.S.C. 578.

My point here is that the public expects both quantity and quality of resource values from the National Forests. Increasing quantities of recreational opportunity, clean water, timber, minerals, wilderness, and red meat. And a sustained quality of the visual resource--a landscape which meets their expectations of naturalness and beauty.

We can actively manage the visual resource in integration with other resource values--as we are doing on the National Forests--to try to meet those dual public expectations.

Professor Albert Lepawsky (1967) of the University of California at Berkeley noted a tendency to counterpoise the attributes of quality and those of quantity--in an inverse relationship, such as, "resource quality declines continuously as resource quantity increases."

That's a basic component of utility theory in economics, too. And no doubt such an inverse relationship does truly exist in many areas of forest resource management where we must make some tradeoffs.

But as Lepawsky points out from a strictly scientific and technical viewpoint, quantity and quality do not necessarily constitute alternative attributes of natural resources.

I believe that by managing the visual resource in integration with other resources on the National Forests, there is a broad range of forest management practices which can be made visually acceptable to the public, and which may in several instances actually enhance both the quantity and quality of the resource values produced.

I hope some of the simulated "field trips" you will take later today will illustrate some of these instances. There is a range of forest practice, made possible through management of the visual resource, where an inverse relationship between quantity and quality does not exist.

After examining the spectrum of multiple use forest land management, I know you will agree that we can actually enhance the visual quality of the forest landscape while accommodating continuing or even increased pressures for other resource values as well.

A moment ago I referred to the need to manage the visual resource in integration with other resources on the National Forests. I would like briefly to enlarge on that idea, before I close.

We can't expect landscape architects to come in after the plans are made, after the silvicultural prescriptions are determined, after the roads are laid out, and then to reduce cosmetically the visual impacts of what is planned. They have to be brought in at the beginning, and their ideas and capabilities integrated with those of other resource disciplines. Then we can use their expertise to help determine what the land management objective should be, and how we can achieve it while maintaining or enhancing other resource values as well.

The Forest Service has more than 250 landscape architects--probably more than any other organization--to help us do that. These people work at all levels.

The first landscape architect employed by the Forest Service, was Arthur Carhart, one of the prime movers behind our policy of preserving large tracts of public forest land as wilderness--policy we established in 1924.

Forest Service landscape architects have been a key part of the interdisciplinary teams which we use for planning on each National Forest. Our experience is that they can help both the public and other members of these interdisciplinary teams visualize alternative land management proposals. And they work across the spectrum of resource uses to help accomplish visual management objectives in concert with other goals. More recently, landscape architects are moving out of staff, into line roles--into jobs as district rangers and forest supervisors--where they will have even greater influence on the quality of the forest landscape.

Our objective in managing the visual resource on the National Forests is not to hide what we are doing in our forest practices

Rather, we are seeking to meet enlarged public expectations from a finite land base. And those expectations include expectations of quality in the visual resource.

In a nation of rising public expectations we must seek to accommodate a close blending of land uses, regulating or moderating uses where we can make them compatible with others for a larger public benefit.

And in another 75 years, as the Forest Service celebrates its 150th anniversary, the Chief may well be a landscape architect. And she should still be able to say that the Forest Service in the Department of Agriculture is yet a young agency--one which has been kept supple and responsive to the expectations of the public it serves.

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Major Challenges in Landscape Planning: Simulated Field Trips

Surface Mining[1]

Robert Leopold, Bruce Rowland and Reed Stalder[2]

Abstract: The surface mining process consists of four phases: (1) exploration; (2) development; (3) production; and (4) reclamation. A variety of surface mining methods has been developed, including strip mining, auger, area strip, open pit, dredging, and hydraulic. Sound planning and design techniques are essential to implement alternatives to meet the myriad of laws, regulations, and mining and visual resource objectives.

INTRODUCTION

Our brief slide introduction of various mining activities should reinforce your conviction(s) that management of the visual resource in conjunction with surface mining is a feasible and necessary undertaking. We have far too long stressed the negative; the time is now to stress the positive.

The purpose of this simulated visual field trip is to increase the audience's (1) understanding of the surface mining process; (2) sensitivity to surface mining-related visual impacts; and (3) awareness of visual impact mitigation and design practices and planning techniques.

OVERVIEW OF SURFACE MINING

Stated in the simplest terms, surface mining consists of removing the topsoil, rock, and other strata called overburden that lie above mineral or fuel deposits to recover them.

When compared to underground methods, surface mining offers several advantages: it (1) allows recovery of deposits which cannot be deep-mined; (2) it usually results in a more complete recovery of the deposit; and (3) generally, lower cost per unit of production.

The surface mining process generally consists of four phases: (1) exploration; (2) development; (3) production; and (4) reclamation.

The purpose of exploration or "prospecting" is to discover, delineate, and prove the ore body. Exploration techniques vary with the commodity and its geographic location These include remote sensing or on-site mappin core drilling to intersect deeper-lying ore bodies, or excavating shallow trenches or pits to expose the ore. For example, uranium exploration in the West combines aerial geophysical mapping and core drilling.

During the development phase, detailed mining and reclamation plans are developed, access and haul roads are constructed, and support facilities and structures are built.

Production is a four-step process, including: (1) site preparation to remove vegetation and other obstructions, and to prepar sites for spoil or waste disposal; (2) blastin and removing overburden; (3) excavating and loading ore; and (4) transporting the ore to a processing plant, storage area, or to market.

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Reclamation involves restoring the land to productive use and controlling on-site and off-site impacts. Reclamation problems and techniques vary with the type of mineral, mining method, regional climatic differences, and regulations.

For example, regulations which resulted from enactment of the Surface Mining Control and Reclamation Act of 1977 require surface coal mines to be reclaimed back-to-approximate original contour. Successful reclamation depends in large part on accurate identification of the physical and chemical characteristics of the overburden and effective segregation of material which will support re-establishment of vegetation.

A variety of surface mining methods has been developed to handle effectively the diversity of geologic, topographic, and climatic conditions inherent in the location of various minerals. These include: (1) contour strip mining; (2) auger mining; (3) area strip mining; (4) open pit mining; (5) dredging; and (6) hydraulic mining.

(1) Contour strip mining is used in hilly or mountainous terrain where the mineral lies in beds or seams. The overburden is removed beginning where the mineral outcrops on the surface and proceeds into the mountain until the cost of removing the overburden exceeds the value of the deposit to be recovered. In the past, this unconsolidated material was cast down the outslope as spoil. Once exposed, the deposit is loosened and removed. This creates a bench on the mountainside with an associated highwall, sometimes exceeding 100 feet in height, which marks the lateral extent of overburden removal. This process is continued generally on contour around the mountainside. Coal in Appalachia and phosphate in the West are mined using this method.

(2) Auger mining is often performed in conjunction with contour strip mining. When the economics of mining stop the stripping, the operator sometimes chooses to extract more of the deposit by boring horizontally into the seam where it is exposed at the base of the highwall, like a carpenter bores a hole in wood. However, it is an extremely wasteful technique. For example, augering coal may recover only 40 per cent of the seam, leaving the remaining 60 per cent in a condition that makes it unrecoverable by existing mining techniques.

(3) Area strip mining is used in flat or rolling terrain where the deposits are extensive and lie relatively near the surface. A trench is made through the overburden, exposing the deposit which is then removed. As each succeeding parallel cut is made, the spoil is deposited in the previous cut. The final cut leaves an open trench and a highwall. Prior to reclamation, the area from the air appears to have been subjected to a giant plow with furrows reaching a depth of 100 feet or more. Eastern phosphate, western coal, and some clays and iron ore are mined using this method.

In recent years, a combination of area and contour strip mining methods called mountaintop removal has been employed to recover coal in southern Appalachia. This method is often used when the coal lies close to the ridge of the mountain, thus allowing economical removal of the overburden above the entire seam.

(4) Open pit mining, also called quarrying, is similar to area strip mining, but it is generally conducted in a localized area resulting in large vertical pits. Unlike area strip mining, the amount of overburden removed is proportionately small compared with the quantity of ore recovered. In many cases, large quantities of ore are obtained within a relatively small surface area because of the thickness of the deposits. In addition, open pit mines are generally in operation over much longer periods of time, often decades. Limestone, sandstone, marble, granite, sand and gravel, iron ore, copper, uranium, mica, sulfur, and some phosphate are mined using this method.

(5) Dredging is a water-oriented mining operation that uses a suction apparatus or various mechanical devices such as buckets, clamshells, and draglines mounted on floating barges to recover the deposits. Tailing piles left at mine sites resemble spoil piles created during area strip mining for coal. This technique is often used to mine gold and sand and gravel.

(6) In hydraulic mining, a powerful jet of water is used to erode a bank of earth or gravel which is either the overburden or contains the desired mineral. Ore-bearing material is fed into slurries or other concentrating devices where the desired product is separated from the tailings (waste). Although extensively used in the past to mine gold, it is a practice that has been virtually eliminated today.

To date, an estimated 6.5 million acres of land, approximately 10,000 square miles or roughly the size of Maryland, have been disturbed in the United States by surface mining activities and associated access facilities. As of 1971, 90 per cent of this acreage was attributed to seven commodities: coal, sand and gravel, stone, copper, clay, phosphate, and iron ore. The current estimated rate of disturbance, which is 225,000 acres annually, will increase in future years.

Over 50 types of minerals and commodities are recovered by surface mining methods. Their nature, extent, and geographic distribution vary widely. For example, coal in different forms is found scattered throughout the eastern, midwestern and western portions of the United States in 34 states.

As our society becomes more complex in its industrial and technological development and needs increased energy sources and independence, the pressure to recover our natural resources will intensify. This inevitably means that surface mining will greatly increase, not decrease in significance in the coming decades. For example, coal strip mining in Appalachia, recently thought to be near an end, is only just beginning, considering development in mining technology and revived national coal production goals. The challenge is to increase production efficiently while maintaining or enhancing environmental and visual quality.

VISUAL IMPACT AND SURFACE MINING

The visual resource, like other earth resources, must be properly managed to maintain acceptable standards of quality. Whether existing quality is enhanced or degraded is a function of the nature and extent of change to the landscape. Surface mining extensively changes the landscape through removal and/or relocation of vegetation and large quantities of earth. Changes in the land's natural form, line, color, and texture that create contrast between the mine and its surroundings constitute the major visual impacts of surface mining.

Examples of these changes include: (1) form - notches or sombreros; (2) line - haul roads; (3) color - bare soil against green vegetation; and (4) texture - excavated overburden.

Surface mining's visual impacts result from basic mining activities and other associated environmental impacts both on-site and off-site.

In the past, improper placement of overburden and topsoil, exposure of toxic materials and inadequate drainage and revegetation have resulted in many environmental impacts, including landslides, erosion, stream siltation, and acid mine drainage.

In the exploration phase, visual impacts are generally slight, due to the limited disturbance caused by drilling, trench excavating, and access road development.

The visual impact of the mining process becomes more intense in the development and production phases due to the large amount of land disturbance.

Although one of the goals of reclamation is to reduce visual impacts, the visual contrast between reclaimed areas and surrounding undisturbed areas often remains for many years.

Changes over time in the mining process due to advances in technology (equipment) and mining methods, and the influence of regulatory laws and their enforcement have affected the nature, extent, and duration of associated surface mining visual impacts. Until the mid-1960's, surface mining was largely uncontrolled with little concern for the environment. Between the mid-1960's and the mid-1970's, surface mining states made enormous efforts to regulate mining and reclamation activities by law. These laws concentrated on reducing environmental impacts, which indirectly lessened the severity of visual impacts. The back to contour provisions of the Surface Mining Control and Reclamation Act of 1977 are the strongest attempt to date to control visual impacts of surface mining, although they apply only to coal.

VISUAL IMPACT MITIGATION

Sound planning and design techniques are essential to implement creative alternatives to meet mining objectives. These techniques must be viewed as principles or objectives and not rigid standards with limited flexibility. Two specific components are generally recognized. They are: (1) regional analysis, which establishes broad visual quality guidelines for implementation of basic land-use planning; and (2) site-specific analysis, which establishes specific visual resource objectives for the site, which may be as large as several thousand acres. Generally, the site-specific analysis of the four categories of stages of mining, as previously discussed, are evaluated, and design changes are proposed if required. Simulation and computer-graphics are a key to complete understanding by all. Let's look at a case study for illustration.

Case Study 1

This case study involves a large limestone deposit in California. At the time of this proposal, there was no specific mining plan, but the proposal indicated these visual impacts were possibilities:

1. Large open-pit mine;
2. Slurry line to deep water port;
3. Power and telephone, water lines, material and housing center.

The visual analysis process included the following computer-generated overlays for analysis of impacts on the visual resource:

1. Seen areas from 36 observation points;
2. Seen area during exploration;
3. Slope map and aspect maps and vegetation;
4. Visual Resource Management class maps;
5. Overlay to indicate degree of visual absorption capability of proposed action.

With these base overlays, the agency now can evaluate a definite mining proposal, including supporting facilities. Quality standards to lessen the visual impacts now can be implemented by management. Specific design alternatives are now identified and implemented.

One federal agency utilizes a design process called a "visual contrast rating process" to insure that all design alternatives are carefully and analytically considered to meet the visual objectives for the site. It has been found to be a valuable tool for planning and design implementation for mining plans, etc. Examples of these various "nuts and bolts technology" are discussed in the subsection on Surface Mining and Reclamation.

SURFACE MINING CONTROL AND RECLAMATION ACT OF 1977

Public concern over the environmental, cultural, visual, and economic impacts of surface coal mining culminated with the enactment of the Surface Mining Control and Reclamation Act of 1977. In the law, Congress recognized that recovery of coal through surface mining methods must continue in order to meet future national energy needs, and they established standards to insure that it would be conducted in a sound manner.

In various sections, the Act requires consideration of the visual environment through explicit language and general legislative intent. In addition, environmental standards set by the law do much to alleviate the visual impacts associated with surface coal mining. Beyond these standards, the final regulations, which translated the law into detailed procedures for implementation, only minimally express visual criteria.

Visual considerations are included in the final regulations in two categories: (1) regulation of present mining practices; and (2) reclamation of previously disturbed mine lands.

Many people believe that in large part the back-to-contour reclamation provision for new mining was adopted in response to public concern for the visual impacts of surface coal mining. As such, additional visual criteria are not required in order to grant mining permits on private lands unless the land has been designated unsuitable for surface mining, nor will they be used to determine variances for post mining land uses. Each state has the discretion to include or omit visual criteria as part of the designation criteria within their Lands Unsuitable for Surface Mining Program (LUSM) and to determine reclamation priorities within their Abandoned Mine Land Reclamation Program (AMLR).

Visual criteria will be considered for permitting surface mining on federal lands and to determine priorities within the USDA Soil Conservation Service's Rural Abandoned Mine Program (RAMP). It's uncertain whether visual considerations will have a role in setting priorities for distribution of research funds.

SUMMARY

With the increasing knowledge acquired by study, practice, and experimentation, surface mining is being developed into an art and science which is increasingly attracting trained professionals of all disciplines. As a result, their impacts are being more effectively utilized in both private corporations and public policy. This trend will increase.

The individuals will have a significant role in the enactment and enforcement (monitoring) of existing and future surface mining laws and regulations. This will be especially true for local situations.

Interdisciplinary team involvement, representing the physical/natural, social/economic, and environmental design arts is the key to the full enactment of surface mining in this country.

Technology will allow the designer to show more clearly planning and design alternatives to all constituents through computer-graphic systems and simulation techniques.

New equipment advances and other technological advances will allow us to accomplish in the future what today we think is unattainable.

The key is a spirit, a belief, a commitment, that we must relate man to earth--for ourselves and for future generations. We have the creativity, the drive, and almost the technology. We need communications among all, and time to enact these beliefs.

The future role of visual resource management in the eyes of the public will significantly increase. This concept will be fostered by all, in recognition that professional planning and design for surface mining is essential for economic, social, and environmental survival and enhancement for the lands of our country.

Visual Impacts in the Urban-Wildland Interface[1]

Arthur W. Magill, Rowan A. Rowntree, and Robert O. Brush[2]

Abstract: The urban-wildland interface is treated as a place where extremes meet--where it is difficult to maintain a visually appealing transition from country to city. Problems are identified in relation to stable cities, urbanizing areas, and developing resorts in the wildlands. The visual problems of urbanization are also discussed in relation to physical impacts such as unstable soils, flooding hazards, and wildfires.

INTRODUCTION

Visual resource management is severely challenged where cities and rapidly urbanizing areas adjoin wildlands. The problem involves the meeting of extremes. At one extreme is the hustle and bustle of our urban society and the metropolitan life support systems which it demands--systems that are usually not designed to blend with the landscapes they are invading. Often urban activities add chaotic visual experiences which may contribute to a sense of environmental deprivation. At the other extreme is the relative quiet and calm of wildlands and farm or ranch lands which are generally prized, not only for the crops and other resources they provide, but for the esthetic and pastoral values which contribute to our physical and spiritual well-being.

Thus the problem is to accommodate some degree of urban development where it impinges on wildland and pastoral environments. Landscape managers need to demonstrate to public administrators and private developers how to achieve necessary urbanization while preserving the visual integrity of our national landscape. However, violations of landscape amenity must be identified before they can be corrected or avoided. It is our intent to sort out many of the visual problems inherent in urbanization. And, while we are pursuing this goal, we expect to uncover criteria which will help all of us to decide what visual integrity really is.

The urban-wildland interface may be likened to an ecotone. An ecotone, in plant ecology, is the transition zone between two plant communities, and generally contains plants characteristic of each community. Similarly, the urban-wildland interface defines the critical zone separating various intensities of urban development from the surrounding unurbanized landscape (fig. 1). This zone generally includes the outer edges of cities and their suburbs where they intermingle with remnants of wildlands--the open spaces. The interface may be very narrow (sharply defined) or quite broad (indistinct), or may lie somewhere between these extremes.

The viewer's perception of the character and composition of the urban-wildland interface is determined by factors falling roughly into three categories: (1) the landscape elements juxtaposed along the interface, for example, residential tract devel-

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Figure 1--The urban-wildland interface is that space in which cities and towns merge with farms, forests, and ranges.

opment against pastureland; (2) the position of the observer relative to the interface; (3) and the various dimensions of the regional physical geography, such as topography and climate. (An important fourth category exceeds the scope of our analysis: the various meanings different people assign to the visual characteristics of any particular urban-wildland interface).

The severity of the visual problems perceived by the viewer as affecting the physical resource base thus depends on the interactions of these three groups of factors. The landscape elements at the interface include landforms (hills or mountains), water bodies (lakes, rivers, or bays), vegetation (grass, crops, or forests), and built forms (bridges, homes, or factories). Vertical masses of buildings, trees, and landforms obscure background elements and restrict the area of landscape seen.

The extent of the landscape seen is affected by the position of the observer--on a ridgetop or in a valley, at street level or on the 17th floor of a building. Similarly, important changes occur in the landscape as an observer walks, drives, sails, or even flies. The observer's sensitivity to seasonal or diurnal screening or tonal changes, aspects of the physical geography, also influences interface perceptions. For example, deciduous foliage responding to seasonal changes has the dual effect of extending and constricting the seen area. In parts of the country subject to snowfall, many signs of urbanization are strongly highlighted by the white blanket, but they do not afford the same strong contrast, when snow is not present. However, this is not always the case, for snow may also mute many urban influences. Even arid lands may be altered by the vivid contrasts covered by seasonal changes. Certain colors, such as brown, gray, and yellow, tend to dominate these landscapes until the infrequent rains work their magic. Then, for a relatively short period, green replaces or combines with brown and yellow in sharp contrast.

Atmospheric conditions--fog, smog, haze, and smoke--also tend to alter optical-visual characteristics. These sky conditions, in conjunction with the aspect of urbanized land and with seasonal and diurnal lighting, may strongly influence visual perceptions at one time and not at another. Cities in which overcast days are frequent tend to look dull and lack the sparkle and texture created by direct sunlight. Another and more extreme example is experienced by people new to Los Angeles who may be awe-struck by the nearness and beauty of the San Gabriel Range when the wind occasionally blows away the shroud of smog.

It is the job of resource managers to respond creatively and effectively to present needs, and more importantly, to seek signs foretelling the cost ahead of tomorrow's problems and find solutions today. Some problems we perceive are suggested in the following discussion.

We identify three urban forms as influenced by a few land use elements and various aspects of observer position, region, and season. Urban forms are defined as (1) urbanized areas--core cities with populations of 50,000 or more and their surrounding closely settled territories (as denfined by the U.S. Bureau of Census); (2) urbanizing areas--rapidly growing cities of less than 50,000 inhabitants and also second-home or remote subdivisions; and (3) rapidly expanding resort developments. Each form tends to impinge on its interface in a slightly different way; a way that tends to reflect intensity of development of the urban form in contrast with degree of remoteness or open space associated with it. At the interface of each urban form with the wildland, there are various combinations of the following built forms: residential, industrial, commercial-institutional, and transportation facilities (fig. 2).

URBANIZED AREAS

Urbanized areas are large metropolita areas or stable cities. At their interface are large residential suburbs or "bedroo communities," commercial-institutional de

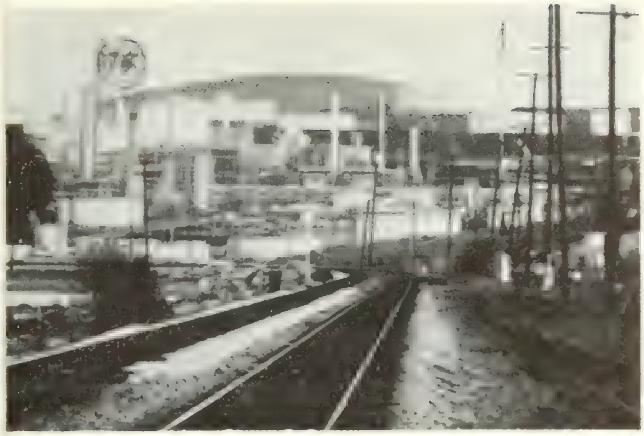

Figure 2--Homes do not create the most noticeable impact at the interface. Design of visually acceptable industrial development is a complex problem.

velopment, and various transportation facilities which may impose strong visual images.

In the West, compulsive urbanization is radiating into our diminishing open spaces as hills are flattened, valleys are filled, and farms and ranches are subdivided. The sprawl is particularly noticeable where lands are expansive and open, where the landscape is dominated by hills and mountains, and where there is little forest to cloak it. Thus, in the process of building homes in natural or pastoral landscapes, we often destroy the very scene we sought.

A major dilemma of Western suburbanization is the choice between ridges or fertile agricultural valleys for home building. Here we have a problem, in part, of viewer position. Would urban dwellers prefer to live on hills and look down into valleys, or would they prefer to live in the valleys and look up to the hills? Although they may not realize they are concerned about "observer position," people pay premium prices to live where they have a "superior view" (fig. 3). And, ignoring the loss of food productivity but not pastoral amenity, we might address the issue of "superior view" in another way, and ask: Shall we build where we can view valleys blessed with crops or view ridges with trees, grass, and cattle? Here we set aside the issue of losing food productivity to gain pastoral amenity.

Where forests cloak the landscape, urban sprawl has a different visual impact. In the coniferous forests of the West, a sharp interface may evolve if the land is completely cleared before any construction begins. This evolution may be more common where lands are rolling or hilly and the forest cover is not too heavy. In such locations, developers have tended to remove trees and shrubs and alter the entire landform to conform with their development plans. Such an approach is particularly undesirable where the relief is quite variable because clearings are more easily seen.

The relatively level landscapes of the East may be better adapted to the "developer-clearcut" because developments and observer viewing positions on flat lands are in the same plane; openings in the forest are less easily seen except as foreground. On the other hand, clearcut approaches to development are probably much less common, because level terrain is less in need of grading. Unfortunately, the deciduous forests which screen eastern developments during part of the year allow considerably more exposure after the leaves have fallen.

Both light and heavy industry, industrial waste deposits, and transportation systems may prove more visually offensive because of scale and obvious structures, than the consequential expansion of large cities and even small towns. When such developments coincide with large or even small bodies of water, they can be especially devastating to the visual integrity of urban areas. What might be done to reduce the impact of oil refineries, steel or paper mills, or other such overpowering industrial complexes at the edge of a bay, lake, or river? What are the options for locating industry where it is not visually offensive, for improving facility design, for developing screening, or for devising less offensive methods of waste disposal? And, if innovative planning and design fail, what legal action, might be taken to pre-

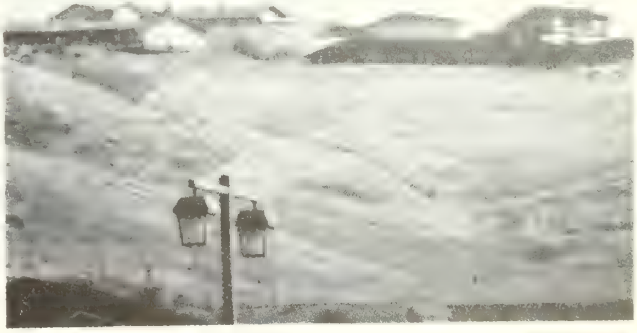

Figure 3--This was prime ridgeland for subdivision, but the view which the homeowners sought is likely to be destroyed by subsequent construction in the valley below.

serve a pleasing visual interface between city and open spaces that include water? Legal case histories already document the precedents for action to prevent inappropriate location of industry on esthetic grounds.[3]

It is not our intent to imply that cities are visually distasteful. Urban areas and wildlands have contrasting beauty, but in each there are misfits--those elements which seem to violate visual integrity. We are merely identifying some of the sources of the urban misfits that occur when the two landscapes merge. We are attempting thereby to create awareness of the urban-wildland interface as an area where strongly contrasting land uses may come in contact. Such awareness may encourage others to develop alternatives that offer visually pleasing contrasts--sequential experiences that provide an enriched transition between wildland and city (fig. 4). Also, we need to know under what conditions are sharp transitions either readily evident or barely noticed by viewers. For, if sharp transitions are unacceptable to viewers, then more gradual ones must be designed.

Freeways, railroads and switching yards, power transmission lines and substations, pipelines, maritime facilities, and airports are necessities which through strong linearity or sheer massiveness may be perceived as visual intrusions in urban landscapes. Highways across wildlands have been of visual concern to natural resource managers. Those same highways, as they approach cities, often become massive freeways which are then the concern of urban resource planners and managers. How can freeways be constructed without overpowering the urban-wildland interface--a zone where auto pathways are more difficult to hide than in the inner city with its massive buildings? How long before we have the technology to put high voltage powerlines underground economically, and what can be done to restore waterfronts lost to decayed pilings and ancient piers? How might hangers, large enough for wide-bodied jets, or long-established railroad yards and rusted old rails be screened from those who are visually offended by them? From a different view, however, railroads and airports, old docks and powerlines, may fit someone's esthetic value system. How might we manage to reconcile such divergent public value systems? How can the urban-wildland interface be treated in ways that please a large cross-section of users as they travel between cities and hinterlands?

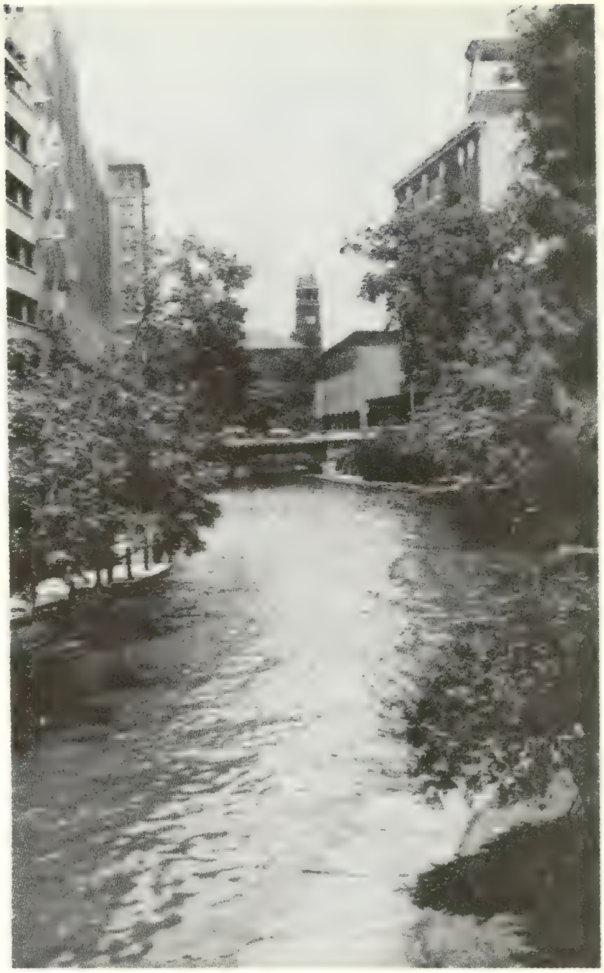

Figure 4--Urbanizing should not be thought of as necessarily distasteful to view. The object is to build in pleasing contrasts between elements of the city and the country.

URBANIZING AREAS

Many Americans, to the extent they can afford to, prefer to live in or near natural or pastoral landscapes. The first persons to move into such relatively undeveloped settings are usually pleased with the surroundings. It is only when many others follow suit that the wild or rural character of the landscape changes to reflect urbanization--the very condition which the first migrants were fleeing. The problem then is one of accommodating some degree of urban development with a minimum of change from the natural or pastoral condition.

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[3] Richard C. Smardon. 1978. Law and aesthetics or when is the pig in the parlor? A legal/policy overview of legal factors influence on visual landscape policy. Dep. Lands. Arch., Coll. Environ. Design, Univ. of California, Berkeley. 155 p.

Subdivisions at the fringe of expanding towns, or second-home subdivisions established as isolated tracts in wildlands, are a serious visual as well as environmental concern. The first few homes built in developments are usually widely spaced and not very obvious except in open country--land with little or no forest cover. Essentially, homes are masked by the forest, but as more are built the forest cover dwindles and the homes are ever more visible. On heavily timbered lands, lot size and tree removal restrictions may favorably influence the esthetic character of urban sprawl and second-home subdivisions. The forest can screen homes from view when lots are fairly large and only hazardous trees are removed along with those on the building sites.

The rapid growth of once-small communities and second-home or remote subdivisions may create contrasts which are acceptable in urbanized areas but visually at odds with wildlands. Golf courses, for example, frequently appear in urbanizing areas and resorts. People with homes along the abrupt ecotone between forest and golf course are usually pleased with their environment, but, nonresidents may regard such development as a strong visual intrusion, as turf is not typical of most forest landscapes. As an extreme example of such intrusion, golf courses have been built in nonurban desert settings creating an environmental anomaly. Even if turf can be maintained, the vivid green is in sharp contrast with the gray-brown tones of the surrounding rock and sand.

Expansion of small towns in relatively open country, or even where small trees such as pinyon and juniper provide the only cover, may lead to severe visual impacts. People may recognize and accept the development as a necessary part of an existing rural community, but would probably be more pleased with less visually obtrusive alternatives, if such could be offered.

Occasionally, all lots in second-home subdivisions may be sold but the purchases are primarily speculative and buyers have little or no intention to build. Roads, sidewalks, utilities, street signs, and even street lights are usually installed by the developers, but home construction does not follow. Consequently, these premature or remote subdivisions became visually evident even though there are few or no houses to be seen. Naturally, the visual impact is greatest where there are few trees or shrubs.

In the past, a few remote subdivisions were fraudulently sold for speculative purposes when development was not seriously intended. Lots were sold at inflated prices, the developer was unencumbered by legal controls (although this situation has changed), and purchasers did not have the advertising power to resell their land even at a loss. Whether failure to build was the purchaser's volition or the consequence of fraud, the outcome of nondevelpment is the same. The visual impact created by unused utilities and roads can only be remedied by removal--a costly process.

RESORT DEVELOPMENT

Wildland areas which have been developed for recreational sites or resorts may sometimes urbanize. Fortunately for the homeowner, such developments generally occur where an excellent view is available. But unfortunately the transient public also gets a view--a view with houses as the foreground of spectacular scenery. Is it possible to allow wildland homeowners to have an outstanding view without spoiling the scene for visitors to such areas?

Some resort developers may provide pleasing building designs and lots which are appropriately situated and spaced within forested areas or on relatively open lands. Visual sensitivity may not be violated at such locations; however, even attractive buildings may prove objectionable to some segments of the public if the buildings are carelessly exposed. Excessive removal of trees may contribute to overexposure. Compounding the problem are trees that are hazardous to life or property. Care should be taken to remove hazardous trees before they cause damage, but if such trees are numerous, their removal may also produce an overly exposed site.

Sleepy mountain resorts may suddenly become popular and erupt as rapidly urbanizing communities. Even support facilities, such as airports, may start small and grow out of proportion. And though attractive buildings may be constructed, the visual consequences of urbanizing resorts can be devastating, whether viewed from the air or the ground. Aerial views, though not common in the experience of most people, provide a broad insight--a preview of emerging problems.

Environmental Impacts As Allies

Visual impacts often suggest the presence of deep-seated environmental problems. A thorough analysis of the visual resource problem at the urban fringe should include consideration of more serious environmental impacts such as air pollution, landslides and avalanches, flooding, and wildfires. The impingement of cities on ecologically unstable natural landscapes produces important interactions between the physical characteristics of both natural landscapes and urban environments, and the visual attributes of urban fringes. In many places, the nonvisual environmental impacts may provide sufficient justification to prevent development which may also be visually undesirable. Landscape managers should use these allies when the violation of a landscape's visual integrity is insufficent cause for preventing or limiting undesirable development.

The sickness of our cities--air pollution--may totally erase visual problems. For who can be concerned about visual violations at the urban-wildland interface if they cannot be seen--when they lie submerged in an ever-deepening sea of pollution. Though curing this illness may not seem to be their concern, landscape managers should support remedial efforts because air pollution not only damages our health, but also destroys the esthetic value of the landscape.

The "visual sensitivity" of a site may be insufficient reason for denying approval for home construction or other forms of urban development, but development can be prevented if the sites are subject to the threat of unplanned land movements. Although areas of unstable soils can be identified before buildings are constructed, soil conditions are often ignored, to the eventual horror of unsuspecting homeowners. And even when the rubble from destroyed homes is removed, what can be done to rehabilitate the resource--not just to prevent continuing erosion, but to restore visual attractiveness? In a few cases, recreational developments on visually sensitive sites might also be precluded by the threat of serious hazards. In the steep terrain of the West, for example, it may have been 50 or more years since an avalanche roared downhill, and spread across an alluvial fan, but that does not mean it will not happen tomorrow or the next day and the next! So, when violation of visually sensitive space is insufficient justification to prevent the construction of recreational facilities or homes, the presence of hazards to life or property may settle the issue.

The problem of wildfires at the urban-wildland interface is of great concern, particularly in Southern California where homes are mingled with the chapparal. Thus, we must learn how to manage vegetation into which homes, often quite expensive ones, have been introduced. The technology to manage for fire protection and to provide suppression is available, but design concepts are needed which will reconcile fire management requirements with the esthetic desires of urban homeowners. A much greater concern, however, is the need for more knowledge about public perceptions and desires for homes built in the interface; methods must be found to induce-- even force--homeowners to design and manage their property so as to reduce home losses while preserving esthetically pleasing home sites. Means need to be identified or developed for more effectively and rapidly rehabilitating areas to satisfy esthetic as well as social and technological goals after fires strike. Once again the problem of building homes in dense wildland vegetation has been emphasized by the recent 27,000 - acre Kanan fire in the Malibu area of California. Estimated loss was $15,000,000!

In conclusion, the urban-wildland interface has been identified as a place where extremes meet--where built misfits may violate the visual integrity of both city and country. We have sought to establish an awareness of how some built forms, including residential areas, industrial complexes, commercial--institutional facilities, and transportation systems, may at various times and in various geographical contexts constitute a problem for visual resource management of large cities, rapidly growing towns, or expanding wildland resorts. Severe environmental problems, such as air pollution, landslides, and wildfires, were suggested as allies for achieving visual objectives where visual amenity could not independently justify restrictive or costly management. We have offered little else to define possible solutions for the associated visual transgressions . However, the talent is available and the technological strength is growing. And these developments should lead to more sensitive visual management of the urban-wildland interface--management to retain some of the serenity and visual gentleness characteristic of less urgent and chaotic times.

Simulated Field Trip on Ski Area Development[1]

John J. Lindsay and Hubertus J. Mittmann[2]

Abstract: Not too long ago winter sports facilities were small and simple. As more people participated in winter sports and technology advanced, the impact on the land increased not only from the standpoint of actual facilities needed for winter recreation but also from associated facilities. In many instances winter sports areas developed into full fledged tourist oriented communities with a multitude of services. Although these areas were initially only winter sports oriented, it soon became apparent that the summer recreationists could enjoy them as well. To make the areas attractive to people, the visual appearance became a key factor in planning, design and construction. Because of this, it was realized that the visual resource management system should be applied to all alterations of the landscape.

INTRODUCTION

In 1978 there were 706 fully operating ski areas in the United States with the combined capacity of serving close to one million skiers per day. Eight percent or 12.8 million people actively participated in skiing during the 1977-78 season. A use increase to approximately ten percent per year is anticipated in the future. Approximately one-third of the total acres are on federal lands.

Ski areas range in size from less than 100 acres to more than 9000 acres. If we assume an average size of 1000 acres including surrounding land development we can estimate a total average allocation to ski areas in the United States of approximately three-quarters of a million acres.

Ski areas are long term commitments of capital and land resources. Their impact on the landscape is permanent and extensive and involves many different environments from the center of ski communities to the base and top of the mountains themselves. They are constructed on a variety of soil and vegetation types that may include critical watershed and wildlife habitats. As you will see, they make significant impressions on our mountain landscapes.

1/Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

2/Associate Professor - Recreation Management, The University of Vermont, Burlington, Vt. and Regional Landscape Architect, Forest Service, USDA, Rocky Mountain Region, Denver, Colo.

SKI AREA DEVELOPMENT IN THE EASTERN UNITED STATES

Mountains in the eastern region are below 6000 feet in elevation and most are well below timberline. They are completely covered with dense forest,making them considerably different from mountains in the West.

A typical eastern mountain forest cover includes pioneer species at the base, northern hardwoods at mid-elevations and northern boreal species at upper elevations. Trails cut through this dense forest cover leave sharp, distinctly visible edges.

Ski areas in the East are located on the relatively narrow Appalachian Mountain Band and are visible from great distances across valleys and flat lands.

In the process of converting a mountain from natural to ski area conditions, several changes are brought about that affect the visual nature of that mountain and proximate areas. These impacts may be classified into the following categories: (1) roads, trails and parking areas; (2) mountain hardware; (3) mountain buildings; (4) satellite construction and (5) community impact.

Usually, new major access roads have to be constructed to the base of the ski area. These roads wind up foothills involving steep grades and deep road cuts through the countryside.

One major step in the early development is bringing power to the mountain.

Trail construction requires the following operations: (1) trail clearing, (2) stump removal, (3) rough grading and (4) land filling and leveling, all of which cause mass transfigurations in the mountain landscape.

During these operations massive machinery must be employed which also causes a major visual impact. Because of lower levels of snow fall in the East, trails must be converted from forest to sod-covered soil to insure maximum stump-free snow depths. Lack of proper trail construction and maintenance can cause unsightly gully erosion and sheet erosion resulting in massive scars on the landscape. Loss of soil and exposure of bedrock result in loss of snow from the slopes because the insulating effect of the soil is lost and reflective radiation from the rock surface is increased. Severe surface erosion transforms clear mountain stream, high on the watershed, into discolored slit-laden rivulets rapidly advancing stream and lake sedimentation further down the watershed. Large land areas must be cleared and leveled for automobile parking near the base facilities. Auto-filled parking lots can be barren, metallic wastelands in an otherwise natural mountain environment.

Mountain hardware that includes lift towers, cables, chairs, gondolas, bull wheels, ski jumps, lighting, snowmaking and grooming equipment further disfigure the mountain with man-made clutter. Line, form, color, texture and scale are all visual impact factors associated with mountain hardware which must be carefully planned and fitted to the landscape. Not only should the color of lifts and other equipment be compatible with its winter environment but also with that of other seasons as well. To help maintain the esthetics of the area and skier comfort, lifts should be designed with a low profile with construction not exceeding tree height where at all possible. Power lift equipment contains massive, mechanical components which occupy large spaces at the base and top of the lift lines.

The average annual snowfall on eastern mountains is considerably less than most western ski areas. As a result, more emphasi must be placed on snow-making equipment. Sno guns and waterlines are other objects that ad to the long list of mountain machinery. Snow surfaces must be constantly groomed in the East to prevent icy conditions and to make maximum use of available snow. For skiers' information, convenience and safety, many sign of varying color, shape and size are utilize throughout the ski area. Unless properly designed and located they can be obtrusive.

One of the largest mountain buildings requiring careful architecture and landscapin is the base lodge. Not only is the lodge the center of winter activity, having many service for skiers but it must be designed to fit other seasonal landscapes for year-round recreation activity. Tennis courts are one example of ski areas' attempts to expand to four-season recreation centers. Maintenance and storage buildings should be built with the same esthetics in mind as any other obvious mountain structure. Mountain-top buildings should be conservatively built below the mountain's profile so as not to offend other outdoor recreation enthusiasts such as hikers. Ticket booths and first aid stations are other types of mountain buildings that must be attractively designed, well located and functional.

Satellite developments such as condominiums, hotels, motels, and chalets also have great visual impact on the landscape at great distances from the mountain. Mountain communities can be nicely adapted to the mountain landscape or very poorly designed and out-of-place with no feeling for the site and its natural beauty. Lodges, hotels and other large buildings, if not properly landscaped, can appear offensive and unesthetic in a non-winter landscape. Condominiums cover large areas proximate to the slopes. Because of this building density and accompanying traffic and activity, they must be built not only to please the vacationing skier, but must also be compatibly planned to fit natural terrain features.

Ski chalets can be contemporary or traditional but should always be matched to the site. Signs in the ski community can be attractive and blending or unattractive and cluttering on an otherwise attractive landscape. State tourist information systems along with state sign control programs can provide the necessary tourist information to the skier thereby reducing the need for private roadside advertising.

Ski area impact on rural communities can be significant in such activities as real estate sales and development, vacation home construction, increased development of entertainment facilities, contracting and equipment sales and rentals.

The impact of a ski area on a community is highly visible. The increased need for basic services such as fire and police protection, sewer and water, create the common community growth and planning problems usually associated with urban communities. Rural communities can become tinsel-towns in the rush to attract skier dollars.

Each phase of ski area development has the potential for causing major changes in the landscape. These impacts can be minimized through careful planning and development procedures.

SKI AREA DEVELOPMENT IN THE WESTERN UNITED STATES

The western mountains are characterized by rugged terrain, high elevation, severe climate and very fragile ecosystems which can easily be damaged. Unless special precautions are taken, recovery from damage usually takes a prolonged period of time. The elevation of these areas is between 6,000 and 13,000 feet.

The following discussion will elaborate on landscape alterations necessary in the development of winter sports areas and the precautions that need to be taken to protect the visual integrity of the area. It should be pointed out at this time that in the West many winter sports areas are also complete summer resorts. This puts a special emphasis on visual resource management.

When dedicating a portion of land to the intensive use of a winter sports area with its associated developments, major visual impacts have to be expected at different degrees during the construction period and after the main construction is accomplished. In the West this type of intensive development can create a major problem because of the difficult land base. It is, therefore, imperative that specific data be gathered and analyzed for consideration of the visual resource during the planning and design process.

A seen area map will have to be prepared to analyze where the area can be seen from, by how many people, time of observation and what type of area it can be seen from such as a highway, a wilderness area or perhaps a summer home site. This map should also include distance zones, sensitivity levels and variety classes of the area. From this information, Visual Quality Objectives can be established according to the Visual Management System used by the Forest Service, USDA.

Another map needs to be prepared which delineates the visual absorption capability of the area. For this we need a combination of data based on slope, aspect, vegetation, soil fertility, erosion potential, mass movement potential and other physical inventories of the area which are pertinent for each individual project.

These are the data which will be considered from the visual resource management standpoint during the planning and design process.

For the more specific discussion of visual resource management in the West we will divide a winter sports area into three major components; the mountain, the base area, and surrounding areas. Within those we will examine landscape alteration from three standpoints; vegetative manipulation, soils manipulation, and structure introduction.

The mountain is probably the most visible aspect of any ski area and because of trail clearing, road construction and structures, its visual impact needs to be very carefully considered. Trail clearing has to take advantage of the fall line, vegetative composition and species which will adapt to drastic change. Width and character of the trails will depend largely on type of terrain, skiers expertise and wind exposure.

To avoid excessive clearing, initially only a narrow trail should be cleared and based on use and possible maintenance needs, successive vegetation removal should be initiated. If a trail follows the fall line of the land it will usually appear more natural. To blend better visually, a trail needs extensive edge effect work to be done over an extended period of time through selective removal or planting of vegetation. A vegetative management plan should be developed for each ski mountain to ensure the visual appearance of the mountain for the future in the summer or winter.

To visualize the trail or other clearing, computer programs such as Mosaic, Scope, or the Perspective Plot program can be used very effectively during the design stage. Necessary changes are then only made on paper.

Once trails have been cleared, the actual skiing surface must be treated to remove undesirable obstacles, provide proper surface drainage and re-establish basic ground cover vegetation, mainly native grasses. Roads on the mountain should be held to a minimum and they should be designed with as little soil disturbance as possible. In the past when helicopter construction and pumping of concrete was not used, roads had to be built to every tower site. The visual impact became unacceptable and so did the maintenance of trails because of excessive erosion.

From the most recent experiences we can conclude that if the mountain alterations are blended as much as possible with the established landscape, the visual appearance will be acceptable and the maintenance cost will be lowered considerably in the long run although initial construction cost may be higher. If it should be necessary that the runs have to be graded, special precautions must be taken to save the topsoil and initiate rehabilitation immediately. Temporary watering may be necessary until grasses are established.

Structure introduction can create a visual impact of great magnitude if not properly handled. Lift structures and buildings, as an example, will probably have the greatest impact. Location, architectural style, colors and vegetative treatment can make the structures negative focal points, or they can harmonize them with the landscape if properly designed from the visual standpoint. The colors used should be dark earth tone colors such as dark brown, dark olive or dark grey, dark blue or other similar shades which blend well into the landscape.

The base area is a completely different story because many facilities and structures are involved. The type of base areas we have in the West range from that of smaller day-use areas to full-fledged winter and summer resort areas. From the visual standpoint planning, design, and zoning controls are the key to success. Many day-use or weekend-use areas usually are not used during the summer and will not treat their area as effectively from the visual standpoint as those areas which are also used as summer resorts.

Basically we need to consider four aspects transportation and utilities, architectural styles, zoning controls, and landscape treatment. All transportation connected features such as parking areas, roads, trails, bus terminals, or signs can have a major effect on the visual appearance and should be well coordinated to achieve the desired positive visual effect. Utilities such as transmission lines, microwave stations and reflectors, water storage facilities and gas or water lines should either be buried or designed in such a way that they will blend well into the surrounding area. The architectural styles in base areas can either unify the area visually or create the appearance of disarray. Use of colors, architectural styles and materials must be well controlled.

Coordinated planning is the key based on the type of zoning which fits each winter sports area best. To achieve the total unification of either small day-use areas or complete resort areas, landscape treatment has to be effectively applied. Grading, planting of grass, flowers, shrubs and trees or saving existing vegetation or water courses can make an area most pleasing and unify it. People like to be in pleasant surroundings and the long-range success of an area can be measured by how well people like it.

There is one other aspect of winter sports area planning from the visual standpoint which is usually considered separately but really should be considered as part of the resort area because the resort is the generato This is the planning of utilities and the necessary transportation system. The visual impact of utilities and roads is usually major and extends for miles affecting large geographical areas. The major utilities are electric transmission lines, microwave installations, pipelines for gas and water, and highways which either need to be built or widened. From thes examples it can be seen that planning of these resort areas has to consider not only the site where the resort is located, but also where the utilities are coming from and what visual impacts they create on the landscape.

Although only major points were touched in this presentation, it is readily apparent that winter sports resorts have a major impact on the visual resource and that planning, design and construction need to consider carefully many aspects which directly relate to the visual perception.

CONCLUSION

Ski areas have emerged from a very primitive start to an all encompassing business serving approximately 13 million people per year and requiring multi-million dollar investments for development by individuals and corporations. The scale of impact and the complexity of area development have increased steadily and require thorough interdisciplinary involvement during planning, design and construction stages as well as in the continuous management process. Because of the landscape orientation and the high visibility of ski areas, visual resource management is gaining in importance in area development. Systems and techniques of visual resource management have been developed over the past ten years and with the addition of computer programs, they should be a major tool in planning, design, and construction to ensure the visual integrity of ski areas.

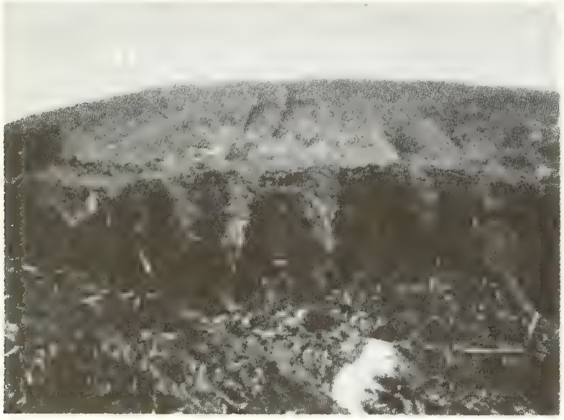
Timber Management Simulated Field Trip[1]

Ronald M. Walters, Warren R. Bacon and Asa D. Twombly[2]

Abstract: Timber Management techniques are changing the appearance of our nation's wildlands. Standard harvest practices often result in harsh visual impacts and public outcry. In some cases, subtle harvesting has been done, but without adequate thought as to what the visual result will be over time. Better visual results can be obtained by careful harvest design which utilizes knowledge of biological and stand growth characteristics as well as landscape architectural design techniques.

Today's wildland landscape is woven with varying patterns of colors and textures. Over the years soils and climate, fires and insects, saws and axes have shaped the forest vegetation into patterns which today lend visual variety to forested landscapes. These landscapes take on meanings for people because of the visual variety and composition of patterns that exist there and we say the landscape is beautiful.

In recent years, man's activities have had a rapidly growing and profound effect on the face of our forested landscapes. Man requires wood for thousands of uses and he must cut down trees to get it.



Early day logging was certainly not pretty. Often the land was stripped bare and debris was left behind without regard for what it looked like. No one really seemed to care very much. There was always more forest over the next hill and everyone knew the wilderness out West was endless.

After World War II, cutting in the western forests begun to accelerate rapidly. Logging roads made forest land accessible and people started to recreate in places they had not been before. Some began to complain about the mess and ugly scars left after clearcut loggi By 1960 when the Multiple-Use Sustained Yield Act was passed it was apparent that something had to be done about protecting some of the scenic qualities of our forest land.

As part of the implementation of the Multiple-Use Sustained Yield Act, the Chief of the Forest Service adopted the National Forest Hig Mountain Policy. A part of that policy established for the first time Landscape Management Areas and Travel and Water Influenc Zones. These were generally nothing more than narrow buffer strips along roads and streams. For the most part, they were not successful because they only tried to hide visual problem behind a thin and often transparent screen of trees.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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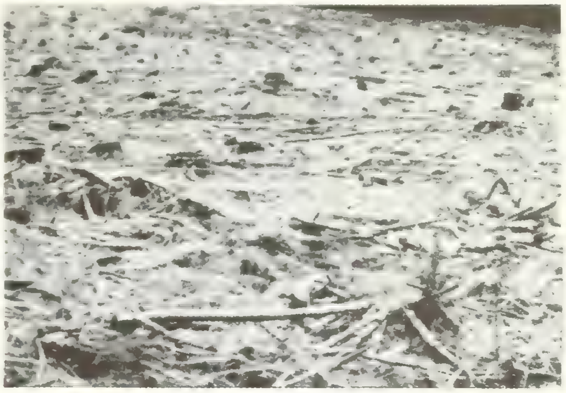
In 1969 at the first National Landscape Management conference the Chief of the Forest Service recognized the Visual Resource as a full-fledged forest resource and launched the National Forest Landscape Management Program.

Since that time the lion's share of the landscape management effort has been directed toward reducing visual impacts of timber harvest. Early efforts to create a clearcut that broke away from the traditional rectangular shape had a cookie cutter appearance but was considered by many to be a giant step forward.

Landscape architects have found themselves on unfamiliar ground when faced with silvicultural concepts, allowable cut quotas, logging equipment, and road building in steep terrain. This was a tough challenge for most. Landscape architects have had to invent new design concepts and learn how to use new tools such as computer programs to help them study clearcut slopes before they are cut. They had to learn capabilities of logging equipment. Most landscape architecture schools did not teach these subjects.

Another major problem is that there are not many people trained in landscape management to meet the demands of the timber sale programs.

Visual management of timber lands has been a major issue in a number of political and legal challenges in recent years. The Bitterroot and Monongahela National Forest controversies over clearcutting were two of those. There were probably other underlying reasons but the primary controversey in these cases revolved around the visual appearance of clearcutting. Slash on the ground after logging, skid trails where logs are dragged over the ground during logging, access roads and landings for logging equipment and the firelines scraped down to mineral soil around the unit to protect against fire spread are some other visual impacts common to clearcutting.



The recent National Forest Management Act and BLM's Federal Land Policy and Management Act both recognize the significant value of visual resource management and specifically direct the planning of timber harvest to meet aesthetic objectives and the blending of clearcuts with the natural terrain.

Today, landscape architects, silviculturists, logging systems engineers, and members of other disciplines are working together on the specific visual problems of managing various timber species. Each timber species presents somewhat different visual management problems closely associated with its growth characteristics. We will discuss a few of the major North American timber types.

PONDEROSA PINE

Envisioned characteristics which are important include large tree sizes, yellow plated bark with deep furrows, open park like stands, grassy ground cover on a relatively flat ground conditionare historically accurate in most situations where ponderosa pine is a climax species and fires are permitted to ignite and burn. These low intensity, frequent fires eliminate most of the brush and young trees which inevitably become established under the low stand densities associated with mature pine stands.

Lack of fire and other cultural treatments has often allowed ponderosa pine and the more tolerant species usually growing with it frequently to be excessively dense, to the point of stagnation. This condition may retard height and diameter growth for decades, resulting in thickets which are nonproductive for wood fiber and of little value as a visual resource.

It is only when the tree diameter growth rate slows and the older bark is exposed to the weather that the anticipated yellow bark characteristics begin to appear.

Individual trees in open growth stands are deeply rooted and quite windfirm. This characteristic permits a wide latitude in management of harvest techniques, without significant danger of loss to windthrow. Such characteristics also allow harvesting without significant visual impact if carefully done.

Management of these sensitive stands has until recently not only kept fire out but also restricted treatment to cutting only the dead and dying trees. If these valuable visual characteristics are to be retained over time the land manager must consider creating and maintaining a balance of stands of many ages within a foreground in order to have replacements for the present old growth stands.

DOUGLAS-FIR

Douglas-fir as found in the Cascade Range of Washington and Oregon is chosen to represent a subclimax species which traditionally has been thought to be a very difficult species to manage in visually sensitive areas.

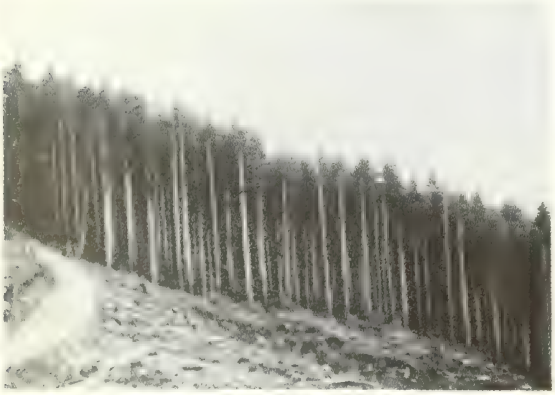
Climatically, the area is dominated by maritime weather patterns, causing a moist and relatively mild climate with long growing seasons. Severe winds often cause windthrow problems in the shallow rooted old-growth stands. Soils are generally well drained, deep and fertile.

The first impression of an old-growth Douglas-fir stand is one of continous texture. Careful examination of any area of significant size, shows subtle differences in the canopy level. These are generally caused by higher or lower site productivity levels, natural variation in seedling density as a result of seed source, actual difference in age as a result of small fires that killed part of the stand, as well as age differences that reflect difficulty of

natural regeneration establishement after the catastrophy that eliminated the previous stand. There really is quite a bit of diversity in what first appears to be a continous stand of old-growth Douglas-fir.

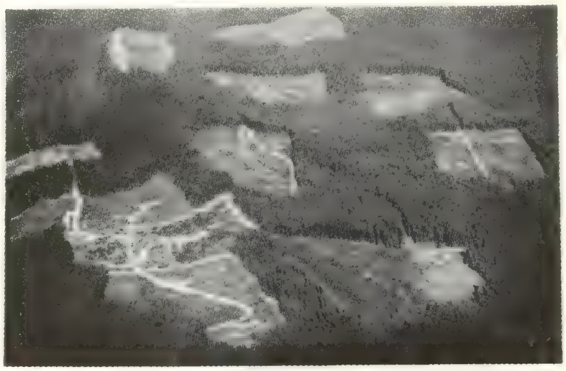
Present old growth Douglas-fir originated over 200 years ago, following natural events as windthrow, fire, and other phenomena. Where the species has grown beside long established openings such as roads and because of soil and climatic conditions, the growth is fairly open and the crowns are often quite long and full. This condition provides visually desirable tree forms in foreground and has a good screening capability for shelterwoods in middleground. It also creates fairly natural appearing edge effects for clearcuts.

However, in the majority of situations, Douglas-fir is typified by tall trees grown in dense stands. Severe light reduction in the dense stands causes the live crowns to be very sparse, occurring only in the top 30 percent of trees, 180 feet to 200 feet tall.



The long unbranched tree boles produce a very strong, unnatural edge effect in clearcuts and shelterwood overstory removals. This strong line at the edge emphasizes the harvest openin and makes a natural appearing effect more difficult to attain.

Soil disturbed to prepare the site for seed germination often produces a strong color contrast with surrounding untreated stands.



The management of Douglas-fir is limited by th species' sivical characteristics, particularly its susceptibility to windthrow and its intolerance to shade. These, together with the difficulty of logging large trees on the steep topography found over much of the species rang limit the treatment opportunities.

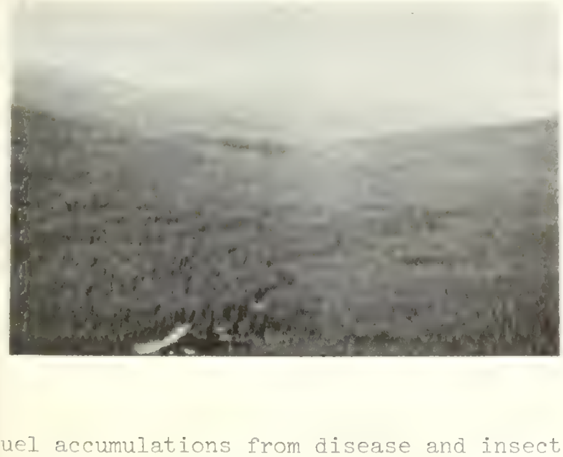
LODGEPOLE PINE

Lodgepole pine can dominate stands originating from wildfire or logging on many habitat types as described by the Daubenmires (1968) in northern Idaho and by Pfister et al (1977) in western Montana. The short-lived nature of these lodgepole stands limits the treatments that a manager, concerned with the visual resource, can use to manipulate the stand over time. On habitat types where lodgepole pine is a dominant seral species, stand decline is underway by age 100 and mortality is usually complete within 200 years (Pfister and Daubenmire 1973).

Lodgepole pine can establish itself so rapidly on disturbed areas that manageable numbers of other species are excluded. Seedling densities which exceed 100,000 trees per acre are common, creating stands which stagnate soon after they become established. Stagnated stands leave the manager little choice but to seek relief with some regeneration method.

Stands that are free to grow face dwarf mistletoe infection beginning at the seedling stage and continuing throughout the life of the stand.

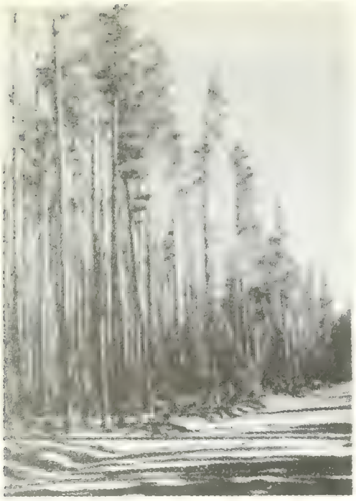
By the time a free-growing stand reaches 80 years of age, it has attained high susceptibility to the Mountain Pine Beetle. Present at endemic levels in most lodgepole stands, this insect can build to epidemic numbers when stand diameters exceed 7 inches. Almost all lodgepole trees in such stands can be killed within several years.



Fuel accumulations from disease and insect mortality make treatment for retention and partial retention visual quality objectives difficult, if not impossible throughout the entire rotation.

On most habitat types where lodgepole is a dominant seral species, lodgepole stands can be converted to other forest types that offer greater treatment flexibility. Culturing lodgepole stands to meet visual quality objectives involves the manager in dealing first with the lodgepole dominated stand to a logical regeneration age, next with manipulating the new stand over time.

Some lodgepole stands have an understory of tolerant species like subalpine fir Engelmann spruce. In most situations it would be difficult to manage for this understory. Partial cuttings to release the understory would increase the susceptibility of the stand to windthrow. This, together with logging debris from the trees removed, constitutes a fire hazard that cannot be reduced without damaging the understory. Complete removal of the overstory would also produce considerable damage to tolerant understories which are susceptible to the effects of logging. Finally, there is doubt that a suppressed understory can be developed into a manageable stand over the long run. Subalpine fir and Engelmann spruce which have been suppressed for long periods of time will exhibit initial release, but it is difficult to sustain their growth to develop visually acceptable stands. These problems point to the importance of regenerating lodgepole dominated stands to new stands supporting more manageable species compositions.



The visual characteristics of lodgepole pine in dominant seral situations range from stands with outstanding variety to those with extreme sameness. The last situation can create visually monotonous landscapes when viewed extensively from off-site.

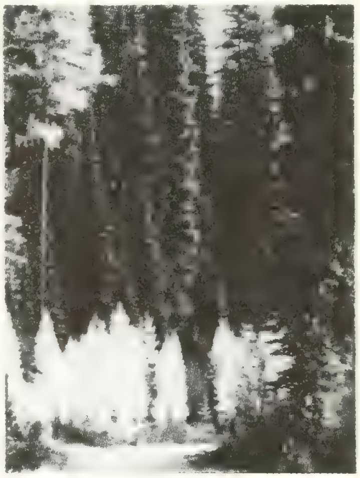
Lodgepole pine trees generally are not considered as individual "specimen" trees; their role is usually supportive in larger visual compositions. Individual trees usually do not offer striking visual opportunities in their form, texture, or color. When viewed collectively they present very strong, line-dominated foreground viewing.

The even growth and branching patterns are usually considered visually undesirable when viewed in the early growth stages; in this growth stage they are commonly referred to as "dog hair" stands.

As the stands are thinned and viewed with other contrasting seral species, such as larch, their visual contribution supports better visual conditions. In situations which allow more shade tolerant species, such as Engelmann spruce and subalpine fir, to intermingle with stands of lodgepole pine and Western Larch a rich diversity of color, form and texture develops. The stand also begins to offer more vertical diversity.

On some habitat types, pure mature stands which lack strong species diversity can offer outstanding foreground landscapes with strong line and shading elements. The forest floor is open and park-like, sometimes with bear grass and occasional clumps of shade tolerant species.

When lodgepole pine is viewed in the middleground, it is most visually desirable when there are a variety of natural openings which develop into strong compositional landscapes of landform, rock form and vegetative patterns. Continuous landscapes of lodgepole pine mixed with larch offer striking short-term fall and subtle spring contrast situations.



A suggested process for converting a seral lodgepole pine stand to the more manageable species of Englemann Spruce and subalpine fir can be found in the forthcoming Landscape Management handbook on "Timber Management Applications."

Summary: This simulated field trip around the United States attempted to portray the physical biological, and social problems and opportunities in managing vegetation to meet Visual Quality Objectives. Suggested conceptual solutions to a few of these timber type problems ar illustrated in the solution statement. Others can be found in the "Timber Chapter" of the National Forest Landscape Management Handbook Series.

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Highway Development[1]

Peter M. Harvard and Bernard L. Chaplin[2]

Abstract: Highways are something we see, and something we see the landscape from. They exert tremendous visual influence on our national landscape and will continue to do so. While most interstate mileage is in place, major unbuilt urban segments remain, and rural and suburban trunk roads are receiving renewed emphasis. Nationwide programs of bridge replacement, safety and environmental improvements, changing design speeds, and the public's demand for a high quality visual environment will all have their effect.

Highways are the cumulative product of numerous small decisions, from corridor location through alignment selection, design, construction and maintenance. Through simulation techniques and effective public involvement, we can minimize and mitigate these cumulative impacts.

INTRODUCTION

Driving for pleasure is a favorite American form of recreation, and much of the pleasure comes from looking at our national landscape, diverse and beautiful as no other nation's, spreading from sea to sea in a rolling, changing sequence of hills and plains, mountains and river valleys. Chances are that nearly everyone has driven the "Trans Am" -- or parts of it -- at one time or another. Whether you started in New England, and drove along coastal plain landscapes hallowed in history, out of the "Bos-Wash" megalopolis, through the Appalachian water gaps, or left the palms and mangroves of the Florida wetlands, moving north through the foothills and battlefields of the Confederacy, into the great central valley of the Mississippi, you ended up in the sweeping plains. Rolling through grass and grain, following pioneer trails turned into highspeed ribbons that disappear into the distance, you pulled into Denve the last stockyard before the grand escarpment of the Rockies. Some of you would have headed south destined for the arid beauty of the southwest and the bright lights of Los Angeles. Those of you who turned north at Denver (or even earlier) might have been lured by the park lands and peaks of Yellowstone and the Grand Tetons, or the Badlands. For you, the passage through the high desert of eastern Oregon or Washington led to the final contrast of the lush dark green Puget-Willamette Basin lying at the feet of snow-capped volcanoes. The view from the road: subject of American myth and poetry.

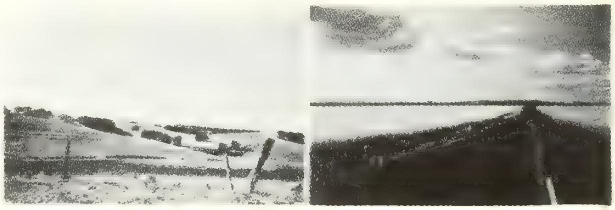

Figure 1--Pioneer trails turned into highspeed ribbons.

HISTORICAL SUMMARY

In the nineteen twenties, only dreamers conceived of driving from coast to coast in a

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Associate, Jones & Jones, Seattle, Washington; Project Planner, Washington State Department of Transportation, Olympia, Washington.

few days. Roads, where they existed, were cart tracks, built with little thought to efficiency and none to esthetics. As the automobile increased in numbers new roads were designed and built, often under the direction of a single person or small team. In some cases, esthetics were considered and the results included some of the beautiful rural roads and scenic parkways that we are rediscovering today as the superhighways become too congested. During the thirties, strong-willed individuals were often able to influence the visual quality of a state's entire road system, inspecting each segment as it was being built and hand-fitting it into the landscape. Later, the demands of a nation at war and a generation of Americans increasingly dependent on the open road for communication, recreation and commerce led to rapid and virtually uncontrolled growth.

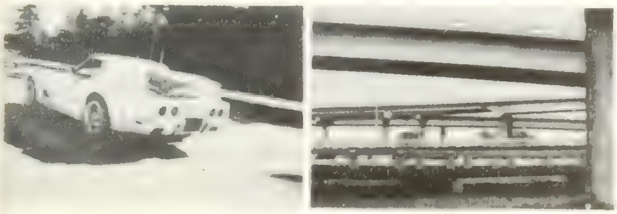

Figure 2--Recreation and uncontrolled growth.

FACILITY TYPES

By the late fifties there was a full hierarchy of roadways in the United States that reflected land uses and the mighty grid of the Public Land Survey. These roads may be divided into functional classes, starting with our familiar urban and rural interstate highways connecting cities of 50,000 or more in population. Urban principal arterials serve the heaviest long distance and passenger traffic, and with their rural counterpart, serve economic development areas. Urban and rural minor arterials vary widely in character but generally serve to connect residential areas to areas of job opportunity. Finally, the vast bulk of the roads in our country is collector and familiar local roads. As engineering techniques grew to meet new needs, designs were developed to solve problems of location, safety and capacity, and the new roads leapt across former barriers and swept, unheeding, past and onward.

VISUAL IMPACTS

As design standards changed to accommodate increased speeds and safety requirements, the visual impact of these new roads became more severe. Now the view of the road and its corridor was offsetting the view from the road.

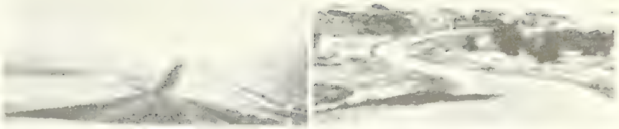

Figure 3--Roads that cut across the land or flow with it.

Many of the impacts can be attributed to the sheer scale of the new highway system and the design short cuts adopted to build it. Initially, decisions on transportation corridors were made using least economic cost as the primary criterion, and highways tended to follow existing rail or parkway alignments. Other corridors were selected that cut across the landscape, rather than flowing with it. As specific alignments were chosen little attention was paid to variations in landform, and highways cut arbitrarily through differing landcovers with little regard for their environmental, social or visual capacity to absorb change. Design effort was sometimes lavished on isolated structures or features. While a cleanly-designed object has its own internal beauty, it is also possible to forget the context of a bridge or roadway and cause the effort expended in design to miscarry.

Major civil engineering works take time, and the scars created during construction can remain for long periods. Many will never heal entirely, leaving contrasting patterns forever.

"Forever," is really the realm of the maintenance crews, and their impact on the highway can be considerable. Routine roadside maintenance, replacement of damaged guardrails, patching, and a host of other so-called "minor" actions can seriously affect the visual appearance of the highway and its corridor.

Highway visual impacts fall into three main areas: first, while highways reveal the landscape to us, they also remove pieces of it from our view; they both create and block views.

Figure 4--Highways reveal and conceal views.

Second, highways alter the visual character of their settings, simply by being there. While a highway can fit compatibly into its landscape, maximum contrast and disruption are too often the case. Highways can introduce forms not previously found in the setting. The linear quality of the highway and corridor right-of-way frequently contrasts with the landscape. The colors of the road and accompanying elements such as signs, signbridges, fences, and plantings often contrast rather than blend into their surroundings. The texture of the smooth roadway and its neatly mown edges may contrast even with grassland landscapes. It takes a large scale landscape to accept the introduction of a modern highway, but there are other reasons that a highway can dominate its setting: the distance from viewers, or contrasting combinations of form, line, color and texture. Highways are also great simplifiers of landscapes, reducing the natural diversity of the setting to a simple swath of grass and concrete, punctuated at regular intervals by lights and signs. All too often an alignment also ignores the "lay of the land," and disrupts the continuity of landforms and patterns of vegetation or human development.

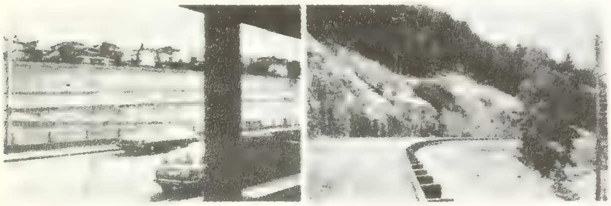

Figure 5--Impacts vary with viewer distance and contrasting combinations of form, line, color and texture.

The third major visual impact of highways goes beyond their lack of compatibility with the setting. Once in place, a highway is the setting, and the impact on the overall visual quality can be devastating. Landscapes containing highways may not be highly vivid, but frequently they do have a memorable quality that is a questionable attribute. The presence of a highway or ancillary highway functions (often outside the R.O.W.) like borrow pits, automobile graveyards and signs can encroach, even upon settings with a strong visual pattern. Often the impact is very site specific, a sign or bridge or retaining wall out of place. Sometimes it seems that highways that leave the landscape intact are the exception. It is unusual to find a highway at any scale that actually adds to the overall sense of visual balance and harmony in a setting, for the overall quality of unity in a landscape is a fragile one. All of these factors vary with the time of day, and change of seasons, as well as the attitudes of the viewer.

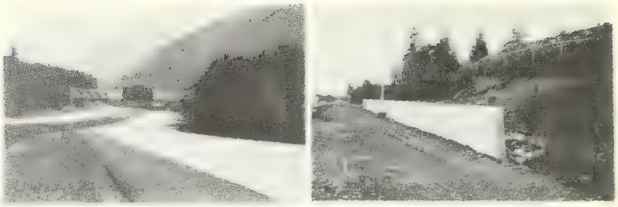

Figure 6--Point impacts: signs and walls.

VIEWER RESPONSE

The last fifteen years have brought about major changes in the way the public holds its agencies accountable. All over the world, protests have aimed at halting public works because of real or perceived social, environmental or economic impacts. Whether the project would take the wetland portion of a major city park and arboretum of national stature, or would carve at rooftop level through an east coast historic district, would open previously wild areas, or bypass aging commercial districts...visual effects have been a frequent cause of public concern, and, in many cases, rightfully so.

NATIONAL ENVIRONMENTAL POLICY ACT

With the passage of the National Environmental Policy Act of 1969 (NEPA) and the subsequent development of regulations, the Federal Highway Administration and individual state highway agencies have all tried to comply with the letter of NEPA. These agencies have been able to address many primary impacts -- for example, air and water quality, noise, and to a lesser extent, secondary development. Nevertheless, few highway professionals have felt comfortable with the issue of visual or esthetic impacts. Training programs are now being conducted which will help them move beyond the "beauty is in the eye of the beholder response and give them techniques to identify and deal with specific visual issues on a point-by-point basis.

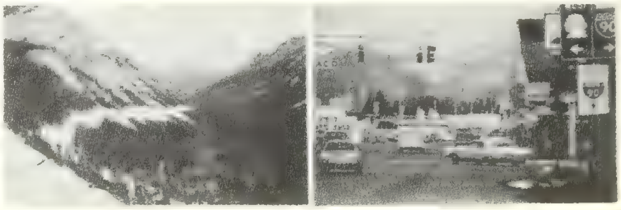

Figure 7--New viewers and old will respond.

SPECIFIC TECHNIQUES

The most important tools for dealing with visual impacts are an explicit resource management process, an effective public involvement process that transcends the traditional impasse of the public hearing, and the use of accurate simulations to convey the landscape setting, the facility characteristics and the alternative solutions. The concept of VRM alternatives and objectives discussed elsewhere in these proceedings (Blair, et al) can be used to link these approaches to management decision-making.

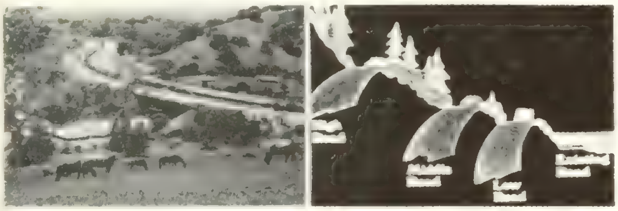

Figure 8--Simulations convey context, character and alternatives.

Visual simulations must be more than the "artists concept," too often seen by the public as a "visual swindle." Computer techniques of visual simulation range from simple sequential plots to more detailed photomontage techniques pioneered by several federal and state agencies. Whether the site is in the Colorado mountain passes or a major eastern forest preserve, computer generated graphics, supplemented by models, are very helpful in developing a common understanding and eliminating distrust due to lack of information.

Where resources and issues permit or dictate, the use of retouched photographs is recommended. This allows the comparison of accurate, true color, before-and-after images.

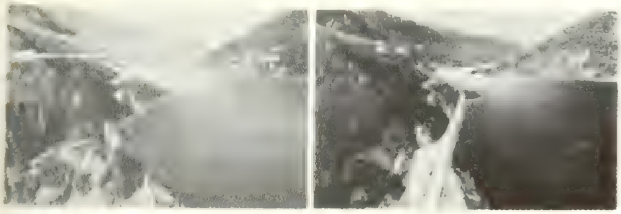

Figure 9--Comparisons from key viewpoints.

Care must be taken to pick key viewpoints and provide the artist with explicit data on the appearance of alternatives, possibly through the use of the computer techniques just mentioned. If resources are limited, simple sketches taken from slides at key, pedestrian-eye-level viewpoints can be effective. Whether simple or elaborate techniques are used, accurate simulations repay the effort with better projects that are more likely to pass the test of community acceptability.

FUTURE ISSUES

Our national highway system has always exerted tremendous visual influence upon our national landscape. This influence will continue into the future. While most interstate mileage is in place, major unbuilt urban segments remain. Rural and suburban trunk roads will receive renewed emphasis. A nationwide program of bridge replacement is underway, along with continuing safety and environmental improvements such as noise barriers and impact attenuators. Guardrails, right-of-way fence and roadside maintenance must be included with traffic signals, lighting and signage on the list of the seemingly humble considerations that have significant visual effects. The visual appearance of the highway is the cumulative result of many individual actions. There will probably never be another burst of freeway construction to match the sixties, but every time we repair or replace a bridge, add a guard rail, change a light standard, or patch a road, we have the opportunity -- and responsibility -- to consider the visual impact of our actions.

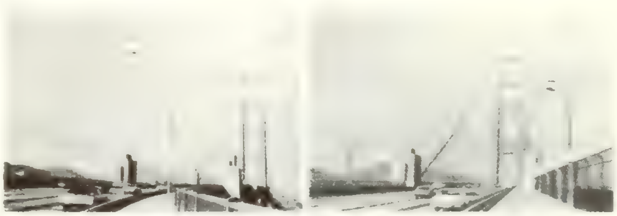

Figure 10--Even changing light standards presents an opportunity.

With increasing interest in rural and wildland travel, we will be facing pressure to upgrade many "country" roads, as recreational travelers flee from the ever-more-crowded superhighways, and rest area design is also becoming important once more; with reduced speeds, we need more pit stops. No matter how hard we strive, esthetics -- like economics -- will always retain its mysteries; but in both cases we must clearly understand the units of value and rates of exchange. We must move beyond cosmetic, add-on solutions that are vulnerable to budget-cutting and offer only symptomatic relief, toward integration of the highway with the landscape. We must base our actions on the recognition that these powerful transportation forms can be at once beautiful objects and visually compatible with their surroundings -- our national landscape.

The Countryside Visual Resource[1]

Sally Schauman[2]

Abstract: This paper identifies the types of visual resource changes occurring in rural landscapes. These types include changes due to agricultural technology and land use patterns. The changes are described in relative dimensions of the landscape elements both as patterns and as individual visual elements. This paper relates visual resource changes to various countryside contexts and thus begins to evaluate the impact of change in certain landscapes. Finally, a process for identifying and evaluating visual changes in rural areas is proposed.

BACKGROUND

The American countryside is a major national asset. Each day we mine, drill, divide, flood, pave or plant some part of the countryside landscape. Before we take any of these actions, we should first understand the countryside's resources. But seldom do we fully understand. Before we choose to change the countryside, we should consider the scenic values of this landscape. Unfortunately, we never do.

In the United States, political concern for the countryside visual resource is just emerging.[3] The study of it is embryonic[4] and frequently confused with the study of visual resources in wildland landscapes. The countryside has received some attention in other countries.[5] In this country the Soil Conservation Service (SCS) works primarily in the countryside. SCS landscape architects are developing tools and techniques to deal with the countryside scenic resource within the evolving theories of visual resources but based on practical field experience.

The visual resource is the consistently definable appearance of the landscape and may be described by the measureable visual elements; topography, water, vegetation, sky and structures and the patterns of interaction among these elements (SCS 1977). Visual resource quality is an evaluation that follows the objective definition of the resource. An evaluation of visual quality is not a simple matter for it occurs within the arena of perception.[6] Regardless of many unanswered perception questions, quality must be identified among generically similar groups. A juicy orange is not a juicy apple.

Visual quality can be determined within a frame of reference (SCS 1978). It is more supportable if it is determined within a context (Smardon 1978). One frame of reference emerges from a study of the visual resource along a section line from the inner city to the pristine wilderness. While an infinite number of discrete units appears along this section, various clusters can be identified. One convenient clustering classifies the section into groups known as inner city, suburbs, countryside, wildlands [7] and wilderness. In SCS we define countryside as discrete units of the landscapes that are recognizable by the predominance of agricultural patterns and activities including interspersed natural areas, woodland and rural communities. Countryside contrasts with suburbs which have denser residential patterns.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-24, 1979.

[2] Landscape Architect, Soil Conservation Service, Washington, D. C.

[3] The first National Conference on the Scenic Quality of Rural Areas was held in April 1979 by the National Trust for Historic Preservation.

[4] Except for the prodigious commentaries of J. B. Jackson, almost no systematic study of the American countryside visual resource exists.

[5] For the range and scope of this work see Davidson and Wibberley (1977), Weller (1973), Coeterier and Dijkstra (1976), Ayso et al. (1976), Williams (1977), and Leonard (1977).

[6] See Melhorn et al. (1975), and Craik and Zube (1975) for discussion of perceived quality.

In time, the lack of scholarship on the American countryside visual resource will be overcome. In the meantime we must begin by analyzing the existing and future countryside. To do this we must see more than the endearing but inaccurate mental graphic of the pastoral farmstead with its hardworking farm family leading the simple but good life amid interesting barns, quaint fences, flowering fruit trees and docile grazing animals. We need to analyze objectively the countryside visual resource now and as it appears to be changing. We in SCS believe we can do this by considering visual elements in the landscape and the patterns these elements display.

VISUAL ELEMENTS AND PATTERNS

Only five elements are potentially visible in any landscape: landform, vegetation, water, structures and sky. All five elements can be modified by human action, but the first four elements provide one ready basis for describing both the existing and changing countryside landscape as manipulated by human decisions.

Landform

The shape of the landscape seems to be the most important element. Perhaps this is true because we also feel the landscape's form as we move either against or with gravity through any given landscape. We do not need our eyes to tell us when we are climbing a hill. Landform is a major factor in most published landscape analysis processes.[8] Many of these analysis techniques relate the magnitude of change or relief in landform to quality. These techniques that assume landforms with the greatest diversity of dissection and the steepest slopes are more desirable.[9] The assumption is reasonable for some—but not all— situations.

For example, many countryside landscapes are croplands with flat to moderately rolling topography which would be evaluated as "minimal" by some prevailing variety classification systems.[10] Yet there is no evidence that the public perceives these croplands as minimal resources, and there is only scant documentation to assure us that the average viewer rates the visual resource of cropland as lower than that of forested mountains.[11] Classification systems that evaluate steep topography with flat landscapes may seem reasonable in countries where the distances are short between natural and agricultural areas. In the United States, however, the distances between countryside and wildland are frequently great. And some states have little topographic relief and almost no wildlands.

Are these areas devoid of high-quality visual resources? It's likely that the residents believe that some distinctive visual resources do exist in these areas. The lack of major topographic relief in countryside landscapes should be interpreted within the countryside context rather than within the context of wildlands. What does the lack of major topographic relief mean in a countryside visual resource situation? Several observations from SCS landscape resource experience in agricultural areas seem reasonable:

1. The horizontal nature of crop landscapes makes them especially sensitive to the presence of vertical elements such as streamside vegetation, shelterbelt trees, farm structures, utility poles.
2. When any topographic relief does exist, it emerges prominently. Thus, wooded drainage patterns become vivid amid cropland, and hill forms are accentuated by agricultural activities such as terracing and stripcropping.

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[7] "Lands unoccupied by crops, pastures, urban, residential, industrial or transportation facilities " (Schwarz et al. 1976).

[8] See Weddle (1973) for summary.

[9] See Forest Service (1973) and Weddle (1973).

[10] See Forest Service (1973 , p. 13)for minimal criteria and Bureau of Land Management (1975) for low quality criteria.

[11] See Mitchell (1974) who found that the "presence of manmade objects is associated with the least-preferred scenes," p. 44; while Zube et al. (1974) found that "... topographic relief ... water, agricultural elements and natural elements ... all have a positive effect on the scenic resource value," p. 103.

3. Since there are fewer elevated viewpoints, the plan views of ground surface patterns are seen less frequently and less extensively. Disruptive patterns can be screened more easily.

4. In rolling and flat countryside areas the horizon line is more uniformly horizontal and is often the most conspicuous landscape edge. Any element that breaks up the horizon line or changes its uniformity becomes very prominent.

5. Not all agricultural activity occurs in flat to rolling topography. Some upland farming includes pastures and orchard crops. When agricultural activities such as tree rows and fences are aligned with the topography, they tend to emphasize the landform.

6. Some flat and rolling croplands are in valleys bounded by relatively rugged topography. The juxtaposition of flat and steep landscapes within the same viewshed gives both landscapes a special visual meaning and, perhaps, even their unique visual identity. The flat fields of the Willamette Valley, for example, are enhanced visually when Mount Hood appears in the distance. Views from the Skyline Drive in Virginia are better because the Shenondoah Valley's orchard crops can be seen below.

   While not as steep or dissected as wildlands, the topography of the countryside varies greatly within its own context. The subtle changes in the visual resource of the American countryside must be studied in relationship to the diverse human activities that occur there.

Vegetation

Vegetation in the countryside includes agricultural crops that vary widely in size, form, color, texture, and planting pattern. Consider the diverse appearances of both the individual vegetative elements and the crop patterns among the following: low annual (soybeans), high annual (corn), medium perennial vine (grapes), high deciduous tree (apples), high evergreen tree (citrus), high palm (date), wetland shrub (cranberries), dryland grass (wheat) and aquatic grass (rice). Consider not only that crops change in appearance through seasons; but also that, on any one landscape, different crops may appear in different seasons of the same year or in the same season of different years. If we add to the visual diversity of crops, the visual diversity of vegetation in the interspersed natural areas, pastures, woodland plots and rural communities, we can see a rich palette of countryside vegetation. Likely combinations of vegetative visual elements need to be sorted out before any classification of countryside visual resources can be made. In the meantime several observations seem reasonable:

1. Shelterbelt and drainageway trees become visually important in landscapes where low crops or pastures are visually homogeneous from year to year. These trees often provide the only spatial definition in an otherwise horizontal landscape.

2. Some crops can screen effectively and therefore can absorb visual intrusions better than other crops. For example, little ground level visibility exists through a landscape of citrus groves or mature corn.

3. If we compare two landscapes with a uniform texture--one an evergreen forest with a uniform height, color and texture, such as a black spruce area, and the other a crop landscape--we are likely to rate the cropland as more visually interesting since it changes in texture, height and color through the growing season.

4. Row crops, especially irrigated crops, give the landscape a strong linear matrix. Any nonlinear pattern located amid these straight lines will be prominent.

5. Some countryside landscapes, such as pastures, idle fields and fallow fields, are predictable locations for seeing wildlife and grazing animals.

   The vegetative visual element in the countryside context is widely varied and often related to agricultural activities

Before we can deal thoroughly with the countryside visual resource, we need to study further the vegetation, the juxtaposition of vegetative types, and the modifications to the vegetative patterns resulting from changes in agricultural technology.

Water

One of the few generally accepted notions in visual resource theory is that water is a desirable, if not a preferred element in the landscape.[12] In the countryside context, water may be one of the more important visual elements. Water is related directly to agriculture, and appears in the countryside in a wide variety of both manmade and natural configurations.

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[12] See Zube et al. (1974), Methorn et al. (1975), and Litton et al. (1974) for indicative references to the importance of water in the landscape.

Consider the visual diversity among these typical water patterns in the countryside: perennial natural streams, field drainage ditches, excavated stock watering ponds, natural sinks, impounded small ponds, rice paddies, natural lakes, impounded lakes, ocean coastlines, lined irrigation channels, natural marshes and natural rivers. The diversity of edge configuration, dimension of surface area and appearance of associated vegetation are but a few of the visual variables in this list. Fortunately, some work has been done on classifying the water element (Litton et al. 1974). We need to establish a classification system appropriate to the countryside context. We need also to correlate the classifications to preferences within a local frame of reference. For example, a lined irrigation channel filled with glistening water amid cotton rows in a desert landscape may not evoke the same response as a similar concrete channel transversing grassland. Is a rainbow created by irrigation vapor any less prominent or desirable than one created by a natural waterfall?

Structures

The words *countryside structure* evoke a rose-colored image from deep in the American psyche: a freshly painted farmhouse, Mail Pouch signs, quaint barns, rustic stone fences and sparkling farm ponds. Unfortunately, the typical countryside graphic no longer resembles either the stark clarity of a Wyeth rural landscape or the beloved scenes of a Currier and Ives print. The countryside now includes interstate highways, transcontinental transmission lines and conduits, regional shopping centers, vacation farmettes, theme parks, airports, national cemeteries, solid waste landfills and mining structures. Until a short time ago the impact of locating these structures in agricultural areas was not widely considered. Only very recently have the scenic resources of natural and manmade resources in the countryside been recognized as they relate to land use (Bergland 1978). More important are the changes in structures brought about by new technology. In any case, no systematic study of structural elements in the countryside exists. We need to identify the factors that give some structures an indigenous appearance while other structures seem to be misfits. We should identify landscape criteria to identify the most likely countryside areas for locating needed but visually intrusive structures with minimum impact.

Patterns

While each of the five visual elements needs to be studied within the countryside context, the pattern of interaction among the elements is also a crucial study need. The patterns or the images of all the elements taken together provide the landscape with its identity.[13] Occasionally, a single visual element gives the landscape a definable identity such as miles of wheat fields. More often, however, it is the combination of visual elements in a consistently describable pattern that gives us our lasting impression of a landscape. The countryside visual resource of the Connecticut River Valley appears distinctly different than the countryside of the Willamette River Valley. Understanding the individual visual elements will help us, but in the final analysis we must deal with the elements together as patterns. We must understand the existing countryside patterns in order to evaluate ongoing changes. We must begin immediately, for surely the rate of change will accelerate.

COUNTRYSIDE VISUAL RESOURCES CHANGES

The American countryside changes rapidly before our eyes but beyond our consciousness and attention. In other countries, the concern for countryside change has become the focus of government action (Davidson and Wibberley 1977). By contrast, American interest in the visual countryside has been low and the landscape architectural study of it has been inconsequential (Schauman 1977). In the countryside context several change agents emerge: urbanization in remote areas (Sunbelt and second homes), urbanization in suburbs (most typical problem), linear systems (roads and conduits), industry and mining, and agricultural production and technology. These agents differ in their potential for changing the visual resource in terms of areal extent, magnitude and degree of permanence. For example, residential structures may be built on only a small area, but they permanently change the visual resource over a large area. Mining activities may make major changes for a short time on vast areas which may be returned to their original appearance. The visual impacts of change due to urbanization, mining and linear systems will be discussed by other conference speakers. This discussion focuses on agricultural trends and changes in the countryside visual resource: idle farms, specialized farming, animal production, farm machinery and irrigation.

Idle Farms

Between 1950 and 1974 the urbanization process consumed 17 million acres of the countryside. More than 1/3 of this land in the fast growth urban area has been classified as open and idle landscapes (USDA 1978). They are often idle farms that have been sold and are falling into disrepair. These are untended landscapes, slowly reverting to nature while patiently awaiting the inevitable shroud of suburbia. Working farms in the same landscapes often appear derelict as a result of neglected maintenance. Soon-to-be demolished barns do not need fresh paint.

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[13] The identity of the landscape is similar to what Simonds refers to as landscape character (Simonds 1961).

Specialized Farming

In all regions of the United States cash-grain farms grew in population by 1/3 from 1973 to 1975 (Williamson 1978). This trend is a result of the increase in the world wide need for American grain crops. Several visible landscape changes result when specialization is in one or two cash crops such as soybeans and corn. Small farms are aggregated into large farms with large field sizes. Many large farms include leased or jointly owned land; the farm operator benefits from the increased efficiency of a large operation, but is not burdened by a major capital investment. The result is that fewer farm operators live on small to medium size farms, while the population of large farms increases. Thus the density of farmsteads in farmed areas is decreasing.

The potential high yield cash crop stimulates the farm operator to use every inch of available land for planting. The visual resource changes in the landscape resulting from cash crop trends are obvious in many midwestern states. The field sizes are larger; therefore, the spatial definition and patterns of the landscape change to a larger, less human scale. The number of farmsteads and the artifacts of the family farmstead are decreasing. The family orchard, pet horses, small herds, animal barns and field fences are disappearing. The farm operator can live in town, buy the family's food at the supermarket, and convert the farmstead landscape to a corn or bean field.

Another type of farm specialization is related to money but not to cash crops. These farms are few in number, but significant in their visual resource considerations. The specialization is gentle farming, often horse or cattle breeding. Here the farm owner resides amid a well tended and carefully managed landscape. In Virginia, the landscape image includes white horse fences, green improved pastures, flowering fruit trees, a main house (often of historic interest), and grazing thoroughbreds. All the landscape elements and activities are in scale and harmony. The countryside image of these farms varies among regions, but the net result essentially is the same. They provide major open space and visual resource values.

Animal Production

Often the farmer growing a corn or bean cash crop will purchase calves to feed during the winter months. Since these landscapes are devoted mainly to crops, few if any permanent pastures or hayfields can be seen. In both meat and dairy production, there is an increase in the use of pellet feed, a reduction in the area in which animals are confined, and a trend to store an increased amount of silage. In addition to a reduction in the general pastoral scenes of hayfields and grazing animals, several visual changes occur in the structures related to animal production. New farm artifacts begin to appear. Making their debut in the landscape are tall blue silos, large roof structures covering expansive feed lots, and waste management systems ranging from simple lagoons to complex tanks, pipes and processing systems.

Farm Machinery

As the size of farms grows larger, the size of the equipment follows. Larger machinery in itself is a small visual change, but the implications of its use are major visible changes. For example, larger, more expensive equipment requires larger, sturdier storage sheds (often made of reflective metal), and larger maintenance areas. Perhaps the most important visual change is the change in field borders and windbreaks. The larger equipment requires a larger turning radius in the field. To give the equipment more room to turn around, many field windbreaks have been destroyed.[14/] The destruction means not only the disappearance of a strong visual change, often the most prominent visual element in a crop landscape, but also an increase in the appearance of erosion.

Irrigation

Irrigation is an ancient technology but a modern phenomenon. The advent of lightweight metal resulted in a cheap efficient system for deploying water more extensively. Current estimates indicate that 80 per cent of all water consumed and 50 per ce of all water withdrawn or diverted in the United States is used for irrigation. Approximately 60 million acres were irrigated in 1977.[15/] The technology of irrigation continues to change as new channel

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[14/] Lloyd (1978) states the destruction of windbreaks has been mostly of field rather than farmstead windbreaks.

[15/] Irrigation data vary considerably because of the varying definitions for types of irrigated land and the variations in reporting systems. These data are a reported in Boone (1978) and McNeill (1978).

linings, sprinkler systems, control devices and drip systems evolve. The conservation of irrigation water becomes crucial. The social, political and economic issues of using water for irrigation are emotion ridden with strong advocates on all sides. In spite of the potential for bias, a few objective observations concerning visual changes due to irrigation trends are possible.

The irrigated landscape has clear patterns that reflect the irrigation system, such as linear channels and circular field patterns. The frequency and distribution of irrigation patterns in the landscape will increase. While most irrigation now occurs in the far West, a wider application of irrigation will be seen. Anyone who has flown across the country in the past 5 years will attest to the spread of the giant green circles.

The impact of new irrigation technology on the visual landscape is conjectural. Drip irrigation has been applied only since about 1968. In those few years, many landscapes previously unusable for crops, have been planted. In California, the newly planted avocado areas are a striking visual change. No doubt new irrigation technology will be reflected in future countryside visual elements and patterns.

CONCLUSION--THE FUTURE

The agricultural changes cited are not a complete list but are only indicators. Compared to other change agents, such as urbanization, linear systems and mining, agricultural changes may be the least noticeable in the countryside landscape. It is not really important to rank change agents as to the magnitude of their impact. It is more important to recognize the cumulative consequences that result when all change agents are in effect. We have only recently begun this recognition process. It is vital that we proceed with some speed. From our experience in the Soil Conservation Service we are convinced the American countryside is a valuable visual resource. We have and will continue developing ways to deal systematically with that visual resource. We intend to develop better visual data to deal intelligently with existing development decisions and to establish a base line to measure future changes. SCS landscape architects have not been issued rose-colored glasses. Rather we are trying to deal with a variable and complex visual resource in the countryside as we see it--not as we romantically remember it.

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Linear Utility Corridors— A Simulated Visual Field Trip[1]

Robert W. Ross, Jr.[2]

Abstract: With the increase in various utility corridors continuing to find their way across the American landscape, more and more people are becoming concerned about their ecological as well as visual impact. This paper examines "linear utility corridors" in terms of those that transport energy and those that transport fuels, their various components, and the types of resulting visual impacts. A brief review of some of the impact mitigating measures currently being suggested and practiced is also presented.

The work "linear," according to Daniel Webster, is defined as: ". . .relating to, or resembling a line or lines; straight. . . characterized chiefly by forms and shapes that are precisely defined by line." He goes on to define"utility" as: "The condition or quality of being useful, a useful article or device - a public service such as gas, electricity, water, or transportation." In addition, the word "corridor" is explained as: "A narrow way, passageway or a tract of land forming a passageway." Combining these words, "linear utility corridor," our definition might very well be: "Tracts of land forming passageways which are used for the purpose of transporting fuels or energy from one point to another in a straight or series of generally straight lines." Linear utility corridors and their visual impacts on our national landscape become our next topic for consideration.

Well over 500,000 miles are dedicated to utility corridors of one type or another in this country today. Due to increasing energy demands brought on by population growth and changing life styles, the requirements will continue to rise at a tremendously sharp rate. Until the late 1960's, little concern and few guidelines existed to provide for proper corridor planning, and associated facility, structure, and site design. As a result, serious visual and ecological problems have occurred and continue to impact a significant portion of the national landscape.

In this paper, we will be exploring the components of linear utility corridors in terms of what they are and where they are located. We will examine the kinds of visual resource management problems associated with them and briefly review some of the impact mitigating measures that are currently being suggested and practiced.

For the most part, linear utility corridors can be discussed in two basic terms; those that transport energy, which would, of course, include power transmission lines of all sizes and shapes and found in virtually every landscape type in this country, and those that transport fuels, which can also be found in nearly every landscape type. These would include pipelines which move oil and gas slurry, CO_2, and various agricultural products. Other facilities that would be considered as components of linear utility corridors can surely include telephone lines and various aqueducts and canals. However, for the purpose of this presentation, we will concentrate on the first two types of corridors: Those that transport energy and those that transport fuels.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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Transporting energy is big business in America today and we can only expect it to get bigger. In fact, according to the Federal Power Commission, the use of electric power has been doubling about every 10 years. They go on to say that per capita consumption of electric power has been increasing, roughly five times as fast as population growth. The United States, with one-seventeenth of the earth's population, consumes one-third of its energy in order to suppor the world's highest standard of living. The National Rural Electric Cooperative goes on to point out that the per person use of energy average in this country is six times the world while our standard of living is five times the world average. As pointed out earlier, power transmission lines and their ever present characteristics can be observed in nearly every landscape type found in the country: mountains, valleys, plains, coniferous forests, and deciduous woodlands. In order to take a closer look at the types of visual modifications that have affected and generally continue to impact landscapes, we can examine three basic areas: modification to landform, modification to vegetation, and the introduction of the structures.

Perhaps it should be pointed out at this time that there is a basic hierarchy of utility lines. Voltage on transmission lines is seldom less than 69,000 volts or 69KV. Lines with less voltage than this are usually referred to as distribution lines; are normally associated with shorter distance; and for the most part, but not always, will create less of a visual impact. Transmission lines of 135 KV and above, which include 230KV, 345KV, 375KV, 500KV, and 765KV have a much greater chance of having major impacts. Although modification to landform due to transmission line introduction can cause major noticeable impacts, as evidenced in many examples, perhaps the more obvious impacts are generated from the removal of vegetation and the introduction of the structures themselves. There are classic examples of the brutal way vegetation was normally removed up until just a few years ago. Although many utility companies have been persuaded to modify this approach, and in some cases, remove only vegetation necessary to facilitate structure placement, the acts of years past are obvious and numerous on America's landscape, and will take years to rectify.

The structures themselves come in a variety of materials, sizes, shapes and colors. Although structure materials are usually selected on the basis of structural strength due to capacity and design requirements, availability of certain materials and their costs are important items of concern to the utility companies. For instance, recently a segment of a major 230KV line, crossing the northern portion of Nevada, was constructed with wood poles instead of aluminum, as was the first segment. The reasons were that the cost of aluminum, cost of fabrication, and the dulling requirement all added up to more than the cost of H-frame wood structures. For the most part, wood structures are feasible for consideration on smaller KV lines. However, the larger "electrical super highways," the 345KV, and above require aluminum or steel for strength and durability. Other facilities normally associated with power transmission lines include generating facilities, such as nuclear, coal, hydro-electric, geothermal and gas, are discussed elsewhere in this publication.

Powerline construction activities also play a significant role relative to visual modification. Access roads, for hauling in structures and equipment for tower site leveling and stringing operations are often required or allowed to be constructed. In addition, staging areas and storage yards have the potential for creating short-term, as well as long-term impacts.

Transporting fuels is also big business in America and can only continue to expand. Major oil and gas pipelines already crisscross the country, and are evident in large metropolitan areas, as well as in some of the most secluded back-country.

Plans are already on the boards for a major CO$_2$ pipeline in the western United States and a large coal slurry pipeline to extend across several western and midwestern States.

Again, by examining the basic components of landform modification, vegetation modification, and introduction of structures, we can easily identify kinds of visual impacts associated with transporting fuels. Although landform change requirements due to the introduction of a pipeline can vary significantly, depending upon topography and whether or not the line is to be buried, some sort of long-term vegetation modification can nearly always be expected, even though there are a few important exceptions. This is dependent upon type of vegetation affected, climatic conditions of the site and construction techniques. Major vegetation manipulation for both above- and below-ground pipelines will have long lasting effects on the landscape

Pipeline structures vary in size from 2 inch to 42 inch diameter, and in some special cases, to 48-inch. Size, of course, depends upon material being transported, distance, and whether the pipeline is being used as a distribution or major transportation line. Although, many pipelines are buried below-ground, circumstances may require that the line be located above-ground, due to special pumping requirements or other surface or subsurface conditions. Some major pipelines are fitted with "shoe-saddle" supports which allow for pipe monuments without damage to the pipe itself. They can be as simple as wood cross ties or as elaborate as steel "H" pilings. Expansion and contraction characteristics of above-ground pipelines create problems that can, in part, be solved through structural design of the pipe itself, as well as the use of "expansion loops" and zigzag configuration. Lines that cross rivers or streams usually require special construction procedures for below grade crossings which can result in bank grading, rip raping, and the development of temporary bridges and dikes to facilitate the movement of equipment and materials. Several kinds of facilities, both permanent and temporary, are associated with pipelines.

Construction requirements on larger lines usually mean large but temporary storage and staging areas. In some situations, such as a camp in Alaska developed as support for the pipeline, a small temporary community may actually become established. Permanent facilities other than the actual pipe often include pumping and metering stations and storage tanks.

Now that we have seen some of the major visual impacts associated with "linear utility corridors," we can ask ourselves what is being done to make sure that this type of action is no longer allowed to take place. Although we sometimes, perhaps often, struggle with the concepts of striving to achieve a workable balance between increased productivity and a quality environment, we do seem to be learning about the importance and benefit of preplanning and early consideration of visual resource management concepts in the design process.

Range Management Visual Impacts[1]

Bruce R. Brown and David Kissel[2]

Abstract: Historical overgrazing of western public rangelands has resulted in the passage of the Public Rangeland Improvement Act of 1978. The main purpose of this Act is to improve unsatisfactory range conditions. A contributing factor to unfavorable range conditions is adverse visual impacts. These visual impacts can be identified in three categories of range management: range projects, vegetative manipulations, and grazing systems. The visual impacts are identifiable in the visual landscape components of landform, vegetation and structures. The impact occurs when the form, line, color or texture of the proposed action visually contrasts with the existing characteristic landscape. The degree of impact is determined by how the action is planned, designed, located and constructed. On the whole, range management activities do not create a significant visual impact on the national landscape, but their appearance must be considered when planning multiple-use land activities.

INTRODUCTION

Grazing of domestic livestock was introduced by the Spanish in the Southwest in the early 1600's. The missions were each stocked with a herd of cattle to sustain the inhabitants and teach the Indians the art of animal husbandry (USFS 1977). By 1880, the western livestock industry was at its zenith and occupied the vast grasslands from the Missouri River to the Colorado Rockies. Government contracts encouraged beef production to supply military posts and Indian reservations. New railroads made it possible to raise western beef for eastern markets. It has been viewed as a romantic time in our history when the cowboy was a hero and field of grass "belly-high to a horse" used to wave across the plains free from brush and undissected by gullies (Hastings 1959). There were wide open pastures, as many cattle as could be grazed and cattle drives as long as you could see. It was seen as the Biblical "Land of Milk and Honey." Soon, however, the implication of t Homestead Act of 1862 would impact this gold scene. In time, the homesteader would crowd the cattleman off the fertile grasslands and force his retreat to the less desirable land to the west. The livestock operator ended u on lands that were too poor to farm. Much o this was fragile land and once the vegetativ cover was damaged, its recovery would take generations. It was also public land where everyone had the same right to use the land. Competition for grass was often bitter and there was no incentive for an individual to consider what was best for the land. Overgrazing became the common practice throughou the rangelands of the west. The winter of 1886-87 hit the cattle industry so hard that it has never fully recovered.

The deterioration from overabuse contin until the drought and depression of 1930 convinced livestock operators that drastic measures would be required to save the industry.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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The Taylor Grazing Act of 1934 brought the first livestock regulation to the public domain range. However, the government agency established to administer management of the range proved to be ineffective in controlling overuse because of the public apathy and a small operating budget. In 1946, another agency was formed to bring the grazing use of public lands into balance with their productive capabilities. By the mid-1960's, range conditions had vastly improved since the 1934 Taylor Grazing Act was passed, but based on the potential of the land, mostly poor conditions still prevailed. The National Environmental Policy Act of 1969 required that an environmental statement be required for all major Federal actions that impacted the human environment. Ensuing litigation by a national organization required the Federal government to conduct such an environmental statement on the livestock grazing program on Federal rangelands. Congress reacted and accepted responsibility for the condition and management of Federal rangeland by passing the Public Rangelands Improvement Act of 1978. This Act authorized increased expenditures for rangeland improvements and declared that unsatisfactory conditions can be improved by: "an intensive, public rangelands maintenance, management, and improvement program involving significant increases in levels of rangeland management and improvement funding for multiple use values." (BLM 1978.)

Since the late 1960's, the public has become more aware of the environment. Travel and mobility have added a great deal to this perception, and attitudes about how our national resources are being used are changing. In the past, range practices were accepted as a way of life, the same as mining, forestry and other resource activities. Today, the public is viewing these activities as competing land uses which must be held accountable for their environmental effects and conflicting requirements. The suit brought against the Federal government regarding "livestock grazing activities" is a good example of this concern.

The visual appearance of range management practices has a lot to do with how well the public accepts the practices. Therefore, the first step in effectively reducing the adverse visual impacts of range management activities is to identify those visual impacts.

Range management as discussed in this paper is divided into three categories:

1. Range projects which are engineered and constructed such as stock tanks, pipelines, fences, etc.

2. Vegetative manipulations such as mechanical, chemical or burning, and,

3. Grazing systems such as rest rotation.

The visual impacts associated with each catagory are identifiable in each of the three visible landscape components: landform, vegetation and structures. A visual impact usually occurs when the form, line, color or texture of a proposed landscape modification contrasts strongly with the existing characteristic landscape. (BLM 1978.)

Each category of range management will be examined for the type of visual impacts that could occur, the degree to which the impacts might become more or less significant due to the physiographic landscape and the effect that time has on the visual impacts.

VISUAL IMPACTS OF RANGE MANAGEMENT

Range Projects

Stock Tanks

The major visual impact of stock tanks is a result of the standard silver color of the tanks which contrasts strongly with surrounding landscape colors. They can be seen from a great distance. Also because of their circular geometric shape, the form and line of stock tanks contrast with natural landscape forms and lines. Another visual impact is the exposed soil "trampled" effect around tanks as a result of livestock congregating at the "waterhole." This impact usually becomes more noticeable over a period of time. As the landscape character becomes more hilly, these impacts become more significant if the tank is at the top of a hill or at the apex of coverging lines. These are key locations in the landscape and the viewing eye is naturally drawn to them. In a forested landscape, the view distance is reduced but a horizontal silvery form strongly contrasts with the verticle green trees. Most of these visual impacts would not significantly decrease over time.

Fences

The visual impact of fences depends a lot on how they are constructed. If the fenceline is cleared with a dozer, there would result a strong contrast in line and color of the soil. The effect would only slightly diminish over time. If the fence was always laid out in a long straight line, the line would contrast with natural contour lines in the landscape. This effect would be most accentuated if the fencelines were sky-lighted along ridge tops.

Bright colored fenceposts create a contrast with the natural colors of the landscape. Because a fence separates pastures, there would be a strong contrast created along the fenceline if the vegetation were of different composition or vigor. These contrasts would vary with the time of year, the degree of grazing on each side of the fence, and the range conditions.

Pipelines

Because the lines are usually buried, the most significant visual impact is the exposed soil that causes a contrast in line and color. Depending on the revegetative capabilities, the scar will usually heal after a short time. As the angle of the landscape increases toward the viewer, such as in hilly landscapes, the contrast would increase. In forested landscapes, if the path of the pipeline were cleared in a swath, the unnatural line created in the vegetation would cause a significant visual impact that would not diminish very much over time.

Windmills and Associated Storage Tanks

The main contrast of windmills is the form, line, and color of the structure itself. A vertical form in a predominantly horizontal landscape creates a very noticeable contrast. Their usual silver color and the motion of the blades also attract attention; however, for the most part, windmills are considered a positive contrast. The associated storage tanks would have similar contrast as described for stock tanks but on a larger scale.

Reservoirs

If the reservoir and embankment form a geometric shape, the form and line would contrast with the natural landforms. As the cattle gather around the "old watering hole" the vegetation becomes trampled and the exposed soil creates a contrast with the color of the vegetation. This effect could get worse over time. If there is a fence around the reservoir, the fenceline itself would create a contrast in form and line. The vegetation inside the fence usually grows unchecked and contrasts with the grazed vegetation on the outside of the fence.

Water Collection Devices

The main impact of structural water collection devices is the structure itself. The form, line, and color of the structure contrast with the natural landscape. If there is a fence around the structure, it would create the same kind of visual contrast as discussed under reservoirs.

Wells and Springs

The visual impact of wells and springs is usually minimal, however, if there is an associated storage tank, this can create a visual impact. The tanks are strong geometrical shapes that can contrast in form, line and color with the natural landscape. As was discussed under reservoirs, there would be a contrast with vegetation inside and outside the fence.

Vegetative Manipulation

The visual impacts of vegetative manipulation usually depend on the size and density of the vegetation, the final shape of the treat area, the technique used to clear the vegetatio and the degree of cleanup or removal. The clos the manipulation looks to what might be conside ed a natural occurrence, the less the impact wil appear.

Mechanical Techniques

Mechanical techniques include discing, rootplowing, pushing, chopping, crushing and chaining.

Discing and rootplowing are usually done on a low growing vegetation such as sagebrush, chaparral and mesquite. The disc or rootplow is pulled behind a crawler tractor and the veg tation is inverted or uprooted.

Pushing is used to control large mesquite and pinon-juniper. A crawler tractor equipped with a dozer blade and usually a push bar uproots the plants.

Chopping is accomplished by use of a drum with cutting blades pulled behind a crawler tractor that forces the plant to the surface and chops it into several pieces.

A tree crusher is similar to the chopping drum but the large blades mounted on drums serve as the wheels of a large, self-propelled unit. This unit is primarily used to eradicat small to medium sized trees.

The chaining technique involves two tract moving in the same direction dragging a large chain between them uprooting plants as they move.

The visual impacts of all these technique could be very similar. If the line between th treated and untreated areas were straight, the form of the treated area outlined by this straight line would create a strong contrast i form and line. The color and texture of the treated area would also create a visual contr If the debris were not cleaned up or winddrowe or piled in high evenly spaced geometric forms, the visual contrast with the natural landscape would be quite noticeable. The size and shape of treated areas in relation to the untreated areas can determine visual acceptability. As variety and harmony increase, the visual impact decreases. An opening created in a dense stand of vegetation is more noticeable than one created in sparse vegetation. These impacts are diminished as new, more desirable species appear and grow.

Spraying

The chemical control of vegetation results in defoliated shrubs or trees. The contrast or visual impact depends on the size and density of the vegetation affected. The larger and more dense the vegetation, the greater the impact. The nature of seeing dead plant materials is to associate them with devegetation and disease and the uniformed viewer might see this as a visual impact. Again, how natural a shape the treated area takes can help determine its visual impact. The impact will usually last as long as the defoliated plant material is easily visible, however, because the effected species can be selected, the ground cover remains and the visual impact is not as great as other vegetative manipulations.

Burning

The visual impact of burning is associated with the psychological effect of fire. That is to say, fire is associated with damage and destruction. The standard management philosophy of fire is to put it out. Therefore, when people see fire-blackened tree trunks and grassland, they think of it as a negative visual impact. This effect lasts until new secondary growth becomes visible.

Grazing Systems

The visual impacts of grazing systems are associated with range conditions. That is to say, how livestock are grazed in a certain allotment affects the perceived visual patterns of the landscape. The perceived patterns are affected by the following factors and conditions: The existing vigor and condition of the vegetation, soil fertility, erosion potential, the availability and spacing of water sources, the number of livestock being grazed and the length of time they are grazed. All these factors and more combine to determine the degree of visual impacts associated with grazing systems. The visual impacts of three basic grazing systems will be discussed individually and collectively.

Seasonal Continuous Grazing

In this system, livestock graze continuously in the same area, year after year. Stocking rates must be low enough to ensure that desired forage plants maintain vigor and produce seed crops. Because of continuous grazing, watering areas are "beat out" causing a contrast in soil color. A pattern of livestock paths become established resulting in a line and color contrast. Depending on the vegetation conditions there could also be a line, color, and texture contrast created by pasture fencelines. The conditions on one side of a fence could contrast with those on the other side of the fence.

Deferred Rotation Grazing

With this system grazing is delayed on a portion of the range in succeeding years until a specific plant growth stage is reached. Grazing is rotated among all pastures during the grazing season, except one, which is deferred each year until after seed of the key forage plants is mature. Visual impacts of this system are less than a continuous grazing system because the deferred rotation reduces some of the vegetative contrast. However, some of the same impacts can occur if each pasture is grazed beyond its capacity.

Rest Rotation Grazing

This system rests the range from grazing at suitable intervals dictated by the growth requirements of key forage plants. It is useful in counteracting the effects of the selective grazing habits of livestock by allowing desirable forage species to recover vigor, produce seed and again reproduce. Three or more pastures are used during the grazing cycle with some pastures being rested while others are grazed. This system is the most desirable in terms of visual impacts because of increased plant vigor and more uniform appearance of the vegetation. Again, overgrazing can create visual impacts similar to other systems, but it would take longer to become noticeable because of the additional pastures.

The critical factor in all these systems, as relates to the visual impacts, is the carrying capacity or stocking rate of the pasture. Over-grazing with any system causes negative visual impacts to the scenic quality of the landscape.

SUMMARY

As described in this paper, the visual impacts of range management vary in degree depending on how the specific actions are planned, designed and implemented in the various characteristic landscape types. A project in one landscape type may look totally different in another landscape type. There are many variables involved when evaluating any type of visual impact. Most impacts are noticeable in the foreground and middleground viewing zones. The more varied the landscape the less impacting they become.

The visual impacts of range management activities vary in degree over the life of the project. The visual impact of site construction for example, will probably diminish over time. Vegetative manipulations are most noticeable within the first five years after implementation. The longest visual impact occurs with grazing practices themselves. Overgrazed rangeland takes a long time to recover and the effects go far beyond visual impacts.

Because of the historical significance associated with cattle ranching, range management activities are not considered a major visual impact nationally. However, as people are becoming more aware of their environment, they are objecting to adverse visual changes caused by highly competitive land uses. It, therefore, becomes more important to consider how range management activities "fit" the landscape in order to reduce negative visual impacts.

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A Simulated Field Trip: "The Visual Aspects of Power Plant Sitings[1]"

Bill Bottomly[2]
Alex Young[3]

Abstract: The growth of our economy is demanding construction of a variety of power plants to generate electricity which is having a significant impact on the visual environment. These power plants will consist of conventional thermal (fossil fuel and nuclear), geothermal, wind and solar power plants. There are several areas where solutions to the visual impacts of these power plants can be effectively addressed - site selection, site planning, and cooperative research towards alternative design. In resolving the visual impacts of power plants and the visual resource, we as professionals and managers must be prepared to evaluate a variety of power plant types and a multitude of conflicts which will exist between the visual resource and other resource concerns.

INTRODUCTION

The growth of the American economy is resulting in the increased consumption of energy, particularly electric energy. This is demanding construction of increased numbers and varieties of power plants to generate electrical energy which is having a significant impact on the environment and the visual resource.

In sorting out our energy needs and their effect on the visual environment we must look at the short term and long term options. For the near future we will still be dependent on conventional thermal power plants to generate electricity. These power plants are powered by a variety of fuels which include coal, gas, oil, nuclear and synthetic fuel combinations. A dependence on "conventional" power plants will exist even if we are successful in conserving energy and developing alternative energy sources today.

Long term projections are varied for supplying electric energy by the year 2000. Some estimates indicate we could still be generating up to 80% of the electric needs of this nation by conventional thermal plants, which will be dependent on a variety of complex factors:

- fuel availability and production
- economic factors or demand levels
- current events
- environmental issues
- energy policy and regulations
- technology development
- public acceptability of alternative energy sources.

The prospects for satisfying a major share of total electric demands by alternative energy or power plant sources by the year 2000 are clouded. The most likely future alternatives for electric energy generation are geothermal, wind and solar power plants. The basic technology for solar and wind power plants exists today and is being tested in prototype or demonstration situations. Geothermal energy is being utilized on a limited regional basis where these power plant complexes can economically supplement existing power grids. Substantial improvements in technology and economics may be available in the near future and influence the implementation of these or other alternative energy sources.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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Projections after the year 2000 are difficult to predict although we know that alternative sources and their associated power plants will play a more important role in supplying electric energy (Moon 1979 EPRI 1978, CDWR 1978).

VISUAL IMPACTS

Let us examine the visual impacts of plants, both for conventional and alternative energy sources.

Conventional Thermal Power Plants - For as long as man has been involved with the industrial age he has depended on centralized production of energy, particularly electric energy to power his machines and light his homes. Traditionally, these power plants have been constructed near population centers. However, as the demand for electricity increases, public concern and environmental controls have forced the siting of a new breed of power plants in areas that are environmentally and visually more sensitive (CAI 1974).

Many of these power plants are "mega colossal engineering masterpieces" and among the largest power plants in the world, creating a visual impact not found anywhere in the natural landscape (fig. 1). These plants could require a minimum site of 1,000 acres for nuclear power plants up to several square miles for coal fired plants to accommodate the generation complex, fuel storage, fuel handling and preparation facilities, cooling structures, support facilities, transportation networks and waste disposal (EDAW 1978).

The visual impact of these facilities is particularly acute in the west - "the last of the blue sky areas." One major regional power plant complex - "Four Corners" - is near some of the most popular visual attractions in the nation (Craig 1971). However, this is not the end. Many multiple power plant complexes have been planned or are being proposed in other parts of the country. A southern utility has begun planning for several such facilities that would require a minimum site of 20,000 plus acres or 30 square miles (Jopling 1976).

Geothermal - Geothermal energy is directly related to the tremendous heat reserves from the earth's subsurface and one of the oldest sources of energy known to man. Current new techniques are exploring and utilizing this heat contained (natural steam and hot water), in impervious dry rock and geopressure formations for electric power generation. Only a small fraction of the gross potential of these sources of energy can be economically used for power generation in the western United States (USDI 1975). The process and equipment used to develop the geothermal resource are similar to oil and gas resources. The final development consists of well heads, pipe line collection systems, power plants and electric transmission facilities. There is much unused land that exists within a geothermal complex. In fact, the space occupied by the physical plant is only a fraction of the total land area committed in a typical geothermal development (fig. 2).

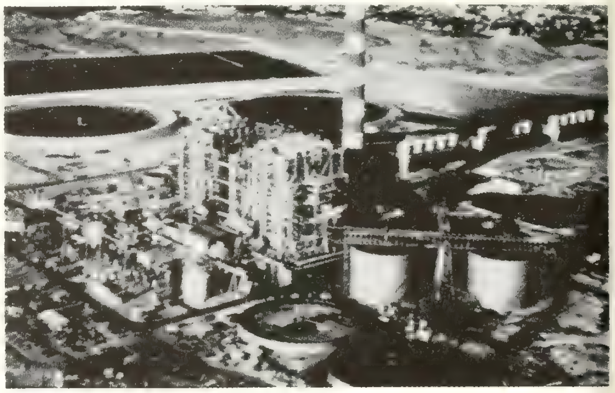

Figure 1--A new generation of power plants is typified by this fossil fueled thermal power plant, courtesy TVA.

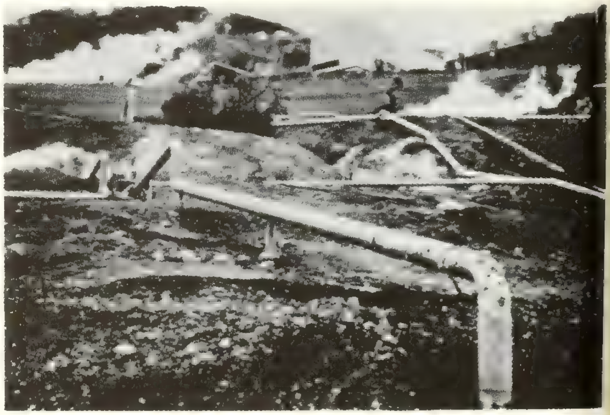

Figure 2--This is an example of a typical geothermal facility in the "Geysers," California.

Wind power plants - Wind has been used to provide a multitude of uses. But with the search for alternative energy sources, wind power is becoming a more attractive energy source. At its optimum wind power could generate only a small percentage of the national energy needs by the end of the century (EPRI 1979).

Typically wind power plants will consist of towers with massive blades and generators, a collection network, and support facilities which will require extensive land areas (fig. 3).

One of the wind power's major drawbacks is energy storage when there is no wind. Additional visual impacts would be associated in solving the base loading problem with pumped water storage or other alternatives.

Favorable sites for these facilities are difficult to predict at this time, since very little reliable data exist concerning suitable wind sites in the United States. A recent study in California indicates that mountainous areas, coastal zones and portions of the more open desert areas are most suitable. A high percentage of these sites is located in areas considered for their natural visual quality, or in highly visual areas close to population centers or travel routes (Hamilton 1975, Hohenemser 1977, Inglis 1977, Lockheed, 1976, Putman 1948).

Solar Power Plants - The technology to utilize the vast energy potential of the sun has existed for some time, yet until recently application of centralized electric generation from solar power plants has not been pursued.

Even though the sun radiates enormous amounts of energy, only the sunbelt regions afford economical utilization of this energy for major power plant sites, while areas of frequent cloud cover would be excluded. This places regional siting limitations upon solar power plants.

To recover this energy economically will require large expanses of solar collectors to convert the solar energy into electrical energy. At this time solar thermal conversion power plants offer the best promise since they utilize present thermal power plant technology. Future solar plants could require over one square mile of generally level land with as many as 10,000 highly reflective surfaces or heliotats (Caputo 1977, Metz 1976, Mayer 1976).

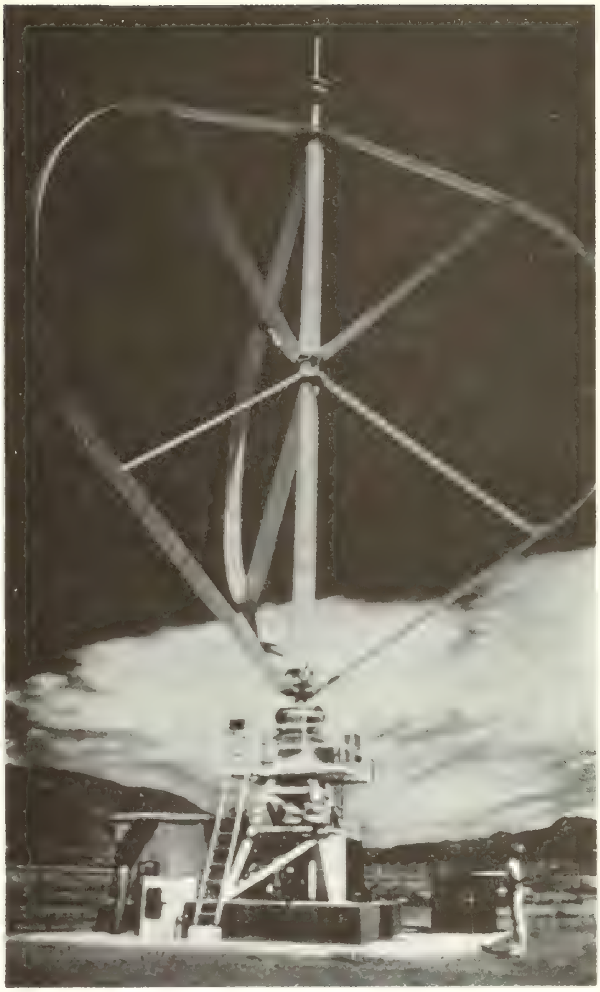

Figure 3--Prototype wind power plant site in Puerto Rico, courtesy EPA.

POWER PLANT CHARACTERISTICS

Now that we have examined the general characteristics of the major power plant types in our future, let us examine the physical components that will affect the visual resources. We must keep in mind that each power plant is unique unto itself and the surrounding characteristic landscape. However, we can make certain assumptions about the visual impacts of power plant components which can be categorized as follows: (EDAW 1978).

1. Fuel storage, energy collection systems or towers,
2. generation complex,
3. stacks,
4. cooling structures,
5. support and transmission facilities,
6. emissions and waste disposal.

Fuel Storage and Energy Collection Systems or Towers - A very significant portion of power sites is consumed by fuel storage and/or collection systems.

Coal fired power plants require large stockpiles of coal and handling equipment whether the coal is found "on-site" or is imported by unit trains, barges or slurry pipelines. This equipment can consume hundreds of acres for "mega" power plants. Other fossil fueled power plants also require storage tank farms of similar size (Craig 1971, Jones/Jones 1979).

The alternative power plant types afford certain advantages of utilizing renewable energy which appear at this time to be environmentally more acceptable. However, these plants require extensive collection systems or structures. Geothermal power plants must rely on deep well fields with collector pipeline systems which can be as much as one mile from the generating facility to supply a typical 100 MW power plant. An average of 500 acres could be affected per plant (Moon 1979).

A "typical" wind generating facility could occupy several square miles to provide economical electric energy. Solar thermal generation plants are being proposed that could cover up to one square mile per plant.

Generation Complex - Another significant visual impact of power plants is the generation complex. This is particularly significant for "mega" thermal power plants with massive boilers and generating rooms. These structures can be as tall as a 10-20 story building and could occupy several hundred to several thousand acres for a multiple plant site. These visual impacts are almost impossible to mitigate totally.

There is some reduction in the size of the structures for alternative energy sources. Geothermal energy plants are generally smaller but require an extensive network of on-site power plants to exploit the geothermal resource economically. This is also true of wi power plant sites which will require a large number of generating powers over an extensiv area to generate electricity economically.

Stack Structures - Another major visual impact is tall stacks of fossil fueled power plants which can be 600-700-feet tall. The visual impact of these structures speaks for itself. In many cases, these stacks are painted in contrasting colors or adorned with lights "for air safety reasons" which makes the structures highly visible. Additional attention is brought to the stacks by the plume smoke (fig. 4).

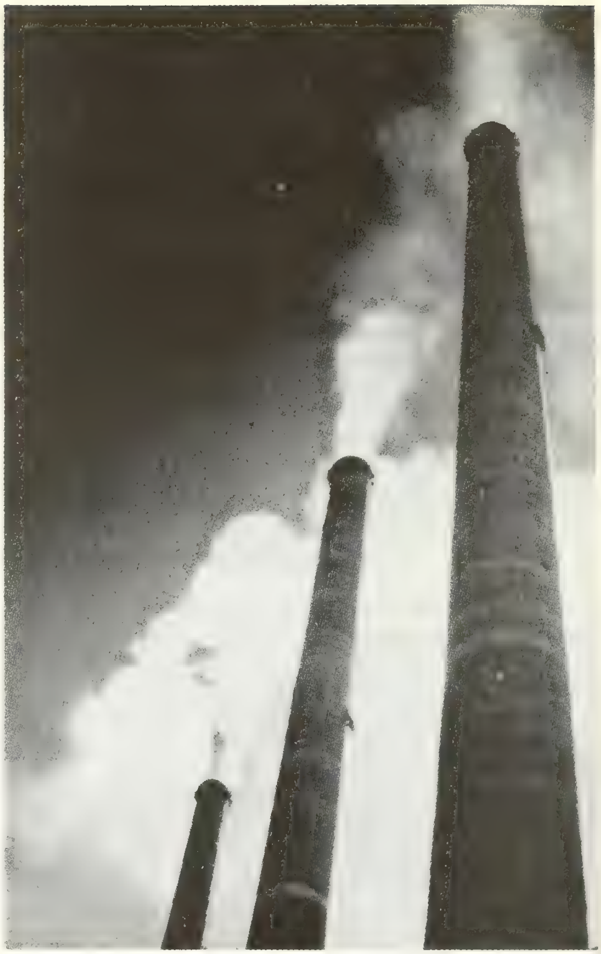

Figure 4--Typical stack at coal-fired power plant.

Cooling Structures - Cooling structures take on a variety of forms and functional aspects. Direct cooling systems are generally associated with sites with abundant water supply along major rivers, estuaries and oceans. The intake and discharge structures usually consist of head walls, channels and/or low dikes while mechanical coolers are low, massive structures and natural draft towers can rise 40-50 stories above the surro ing landscape. The total number and size of units will vary with the size and type of power plant. In the case of cooling towers and mechanical coole water vapor brings additional attention to and accentuates the physical structure (Jones/Jones 1

Cooling ponds and lakes or lagoons are gener ly not associated with major physical structures but impact significant total areas. In more arid climates dry power plant sites may need to import water by aqueducts or open channels which create additional visual impacts.

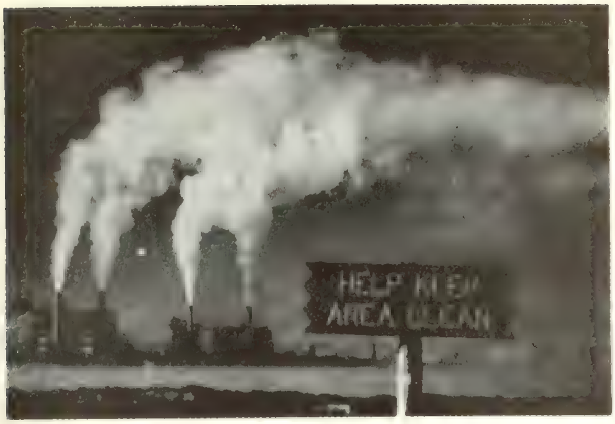

Figure 5--Stack emissions from Four Corners power plant.

Support/Transmission Facilities - Major power plants regardless of the type of energy source will require additional structures to house control rooms, store equipment and for electric transmission (switch yards). These facilities are generally low profile structures but add to the total site impact.

Other visual impacts are associated with transportation systems or service roads, which will vary with the energy source and terrain. Extensive transportation systems are generally associated with fossil fueled power plants which must continually import coal or other fossil fuels on a daily basis. These facilities consist of rail yards, docks or pipeline systems. The visual impact of service roads is particularly acute for alternative energy power plant sites which cover extensive areas to service the energy collection systems (EDAW 1978).

Emissions - The impact of power plant structures and support facilities is obvious. However, there are less obvious visual impacts associated with other resource concerns - air quality and waste disposal!

If there is a return to reliance on coal powered electric generation, tons of fine particulate matter and gaseous pollutants will be pumped out at a high rate impairing the distant scenic views. In the Four Corners example, the "plume smoke" can be detected 200 miles or more from the point source. Newer technology for cleaning up the air could reduce the problem but never completely cure it.

Recent amendments to the Clean Air Act require visibility be protected on the same level as health hazards (fig. 5) (Smardon 1978). However, the law does not provide guidelines for assessing the scientific aspects of visibility deterioration. Studies have been conducted that obtain related measurements via Nephelometer and photographic, techniques or methodologies. There are also several visibility models related to particulate concentrations to visual range (Ziler and Wagner 1979).

Large quantities of waste material are also generated in energy production, particularly fossil fueled thermal plants which create tons of fly ash and scrubber sludge which must be disposed of on site or transported to dumps or utilized in construction materials.

MITIGATION OF VISUAL IMPACTS FOR POWER PLANT SITES

In assessing the visual impacts of major power plants we must remember that the impacts will vary within the landscape, depending on the specific power plant configuration and the characteristic landscape. It is difficult to address specific solutions; however, we can point out several general areas of concern where the visual impact of plants can be effectively mitigated.

Site Selection - We must look at site selection as a primary mitigation for visual resource management regardless of the number or configuration of the components or energy source. Because of the size of power plants architectual or engineering solutions do little to improve the appearance of large scale engineering marvels and usually come off as "decorative" statements with little relation to the visual environment. More attention should be made in selection of sites with higher visual absorption capacity and lower visual sensitivity.

In the past ecological and engineering concerns took precedence over visual resource values. Times are changing however. Many models have been developed to aid in site selection which consider all factors including the visual resource.

More recently the U.S. Nuclear Regulatory Commission denied the permit for construction of a nuclear power plant in Green County, New York, based on a number of factors of which the visual resource was a primary consideration (NRC 1979).

Site Planning - Even after the site is selected proper attention to site planning is essential. Site planning techniques are most effective in mitigating the visual impacts of arrangement and screening of low level components.

This is particularly true for centralized facilities such as conventional, thermal and solar power plants. However, the diverse site requirements of wind and geothermal power plants will require development of innovative site planning techniques to reduce visual impacts.

Total site dedication to energy supply can lessen total acreage required, and be a deliberate design alternative to minimizing individual impact of dispersed sites.

Alternative Design - Alternative physical design of power plants is another effective tool in mitigating the visual impacts and could offer structural architectual and/or engineering efficiency. Therefore, cooperative research is needed for design concepts, particularly for newer technologies, otherwise we will be confronted with visual impacts equal to or exceeding those of conventional thermal power plants of today.

Conflicts and Consideration - In resolving visual impacts of power plant sites there is a multitude of conflicts which exist between visual resource values and other resources. These conflicts must be recognized if visual resource management is to be an effective management force. For example, large cooling towers add high contrast forms to the environment and bring added attention to themselves with large plumes of water vapor. Direct cooling would eliminate these structures but the solution may conflict with public concern for other resource values.

In the Geysers geothermal area of California, plants are located on more prominent visible sites to increase air circulation and reduce potentially toxic gases that accumulate at lower less visible sites. Other conflicts arise from the specific nature or location of the energy source-solar, wind, and geothermal which restricts the options in site selection and site planning.

IN SUMMARY

We can assume that for the foreseeable future the major visual impacts of power plants will be associated with thermal power plant complexes on a national level and with a variety of alternative energy power plants on a regional level. In addition to the fundamental socioeconomic and environmental problems of siting power plants, visual resource management is becoming a more critical issue as suitable sites with minimum environmental impacts are becoming scarce. We, as professionals and managers, must be prepared to evaluate and deal with visual impacts for a variety of power plant alternatives.

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Dams and Water Developments[1]

Robert H. Schueneman[2]

Abstract: The U.S. Army Corps of Engineers is involved in the construction and regulation of many activities relating to water resource development. Such activities include dams and reservoirs, channelization and erosion control on rivers and tributaries, and coastal works. These activities can result in an array of visual effects depending on the specific activity type and means of implementation.

An array of water resource activities typically impacts our natural watershed systems. Such activities include dams and associated reservoirs, flood and erosion control on tributaries and rivers, the regulation of dredging and filling, and the protection of shorelines. For our portion of the simulated field trip, we will follow a natural progression of those elements found at the headwaters and downstream to the coastline, primarily of the west. We should emphasize that many water resource activities significantly alter the character of the natural landscape, particularly those activities whose elements are architectonic and imposing. However, some activities may enhance landscape values which were monotonous, lacking in visual diversity beforehand. Other landscapes can be rehabilitated after the activity has ensued resulting in little discernible visual impact.

Water resource development is probably best exemplified by the concrete dam. In the early 1900's these structures, such as Roosevelt Dam in Arizona, were first constructed to relieve increasing demands for irrigation. By the mid-thirties, the concern for flood contro became equally important to garner support for dam construction.

Characteristically, in terms of size, for material and texture, the concrete dam is an imposing structure in relation to the natural landscape. However, this hardened image can take on an ephemeral, fanciful quality simply by water cascading over its spillway. Earthen dams can have an overbearing visual impact, a well, considering their austere form, juxtapo with the natural topography, and texture, sin their embankments are often void of woody veg tation native to the locale. Appurtenant str- tures are often associated with dams such as outlet works, power generating facilities and fish ladders to facilitate migration. Fish hatcheries are often constructed downstream from the dam to mitigate loss of fishery valu since the reservoir may not provide a suitabl or sustaining environment for many species.

Construction activities present many vis impacts such as denuding expansive areas of vegetation and conveying fill material to th site, whose quarry may remain evident long af the project has been completed. As the dam slowly evolves, it begins visually to dominat the surrounding environs. Roads and bridges are normally relocated from the proposed rese- voir area often requiring extensive cutting and filling operations. Particularly in hot arid climates, cut and fill slopes may remai scathed for several years.

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Today, the construction of dams is not universally endorsed. Fewer optimum locations for flood control and power generation, adverse environmental impacts, costs, and the feasibility of non-structural alternatives have diminished the dam's role in solving our water resource problems of the future.

Bodies of water may visually enhance the landscape and can provide recreational benefits. We often idyllically perceive the act of recreating and quite often our expectations materialize, like sailing or camping adjacent to impounded water. But all too often, recreational areas become over-utilized resulting in the visual and physical deterioration of the environment, particularly, as more and more accouterments of our culture subjugate the natural setting. Poorly designed facilities can further erode visual quality although such problems can be resolved by rehabilitation providing their use is controlled in relation to the carrying capacity of the site. Even recreational facilities that are propitiously designed can have a cumulative effect on those landscapes that were pristine in character.

The operation of man-made reservoirs frequently results in drawdown to increase storage capacity, to utilize water for agricultural, domestic and industrial purposes and to generate power. The fluctuation in water level creates unsightly mud flats devoid of vegetation and shorelines susceptible to erosion. Several agencies are determining what plants can withstand this extreme fluctuation in water level; this process is slow and the results are inconclusive since many species that are usually vigorous growers have not responded in a like manner under these conditions. As a result, rip-rap, gabions or other artificial means are frequently employed to control erosion.

In the southwest we often encounter flood control structures, both concrete and earth fill, which only impound water during infrequent but often intense flooding conditions. These structures whose embankments may be barren, rip-rapped slopes can visually dominate those flood plains that are expansive and uneventful. In rural settings, the flood pool area may be available for agricultural use; frequently, these dry reservoirs are in suburban areas and provide excellent opportunities for intensive recreational use such as golfing, athletic fields and playgrounds. Within the dry reservoir subimpoundments can be constructed to enhance wildlife, recreation and scenic values, while not affecting flood control capacity.

The visual aspects of streams and rivers can be radically affected by adjacent land use. In urban areas the character of such streams can be negatively impacted by encroaching development, often oblivious to potential visual and recreational amenities. Development occurring within the flood plain is susceptible to periodic flooding and damage. Under these conditions, when the carrying capacity of the flood plain is severely impacted, we often employ structural methods to control flooding. While such solutions may not enhance the visual quality of the landscape, large volumes of water are efficiently conveyed.

Many materials and methods of construction are employed in channelization projects. Some flood control channels are earth bottomed with riprapped slopes; given time, vegetation may become established softening the structural framework. When the right-of-way is restrictive, vegetation can be planted and irrigated to encourage rapid growth for screening. If the right-of-way is of sufficient breadth, the alignment of channelized streams can be varied to avoid existing vegetation altogether. Concrete channels can be completely buried possibly creating an artificial stream bed above by pumping water from below, a deceptively naturalistic solution. Flood walls are used along large rivers resulting in their visually isolation from the surroundings. Austere floodwalls can be superficially altered by texture and form or murals painted by local teenagers during their summer vacation.

Since these flood protection projects are usually located in urban areas, their rights-of-way may present excellent opportunities for hiking, biking and, occasionally, equestrian trails, linking residential areas with schools, stores and parks. However, to provide any type of public access within the right-of-way, usually strong objections from adjacent homeowners have to be overcome.

Sometimes a bypass channel is constructed to carry flood water around an urban area. While the river is preserved, the channel may be oblivious to the integrity of the landscape. In urban areas, these bypass channels insure stable flows through the city, enabling intensive development along the river's edge. If propitiously handled, as in San Antonio, Texas, the river can become a visual amenity and foster economic growth.

We are required to first consider non-structural solutions, particularly, within flood plains that have not been severely impacted by development susceptible to flood damage. Indian Bend Wash, in Scottsdale, Arizona combines structural inlet and outlet works with a greenbelt floodway, containing trails, parks and other compatible facilities. In addition to these flood control projects, we are often involved in river bank stabilization to deter severe erosion. Although extensive grading and placement of material may take place, existing trees can be preserved, subduing the contrived bank.

Coastal work is an important function of the Corps. Projects vary from the construction of ship channels to beach renourishment. We also construct breakwaters to protect harbors and shorelines from wave action often creating habitats for fish and wildlife. Unrestrained development can disrupt the natural process of deposition, resulting in severe beach erosion. Huge, jack-like structures called dolosse are sometimes used to protect shorelines. While the visual impact of such structures is austere and imposing, further erosion is often contained.

Dredging navigation channels is one of our oldest activities, and depending on how the fill material is disposed, no visual impact may result. Sometimes dredging is done by pipeline creating fill areas which simulate natural sandbar nesting and feeding areas for wildlife.

Presently, we are regulating filling operations performed by others in wetland areas, activities which have destroyed countless acres in the past. Fresh water wetlands are susceptible to diking and draining for agricultural purposes or quarrying operations. Saltwater marshes often succumbed to the pressures of urban development. We also must approve and issue permits for all structures to be located within navigable waters. Individual boat docks may not have significant visual impact but their cumulative effect can be consequential.

While there are many other examples of water resource projects, our simulated field trip has given you a broad indication of our involvement. We have briefly discussed dams and reservoirs, channelization and erosion control on rivers and tributaries, and coastal works - projects which have significantly affected our visual environment.

The Off-Road Recreation Vehicle—Visual Impacts[1]

Stephen F. McCool[2]

Abstract: The off-road recreation vehicle (ORV) has become a major influence on the character of wild landscapes. Visual impacts resulting from ORV use are shaped not only by site-environmental variables, but also by the nature of the recreation experience users seek. The problem is further compounded by conflicts between ORV's and other recreational uses. Solutions to ORV-induced visual impact problems will require further understanding of the specific behaviors of ORV users.

The pre-dawn stillness of a spring day on the desert tells many things to the sensitive listener. It is a period in the diurnal order of things which nature seems to have designed for those who appreciate ecological stability, diversity, and beauty. As the darkness evolves into gray and then into a brillant eastern horizon orange, the sensitive observer discerns a landscape rutted by the previous day's recreational activities. Just as suddenly as the sun breaks above the horizon, the arid serenity is shattered by the sound of a motorcycle revving up for the first climb of the day.

The off-road recreation vehicle (ORV) and its impacts are one of the most challenging visual management tasks facing land managers today. They have become a pervasive influence on the character of wildlands in the United States. Only two short decades ago few places in the country had been touched; now in the late 1970's many critics claim that there is hardly a locale exempted from the visually disruptive influence of ORV's. Two decades ago, the number of ORV participants could have been counted in the hundreds of thousands; now we number them in the tens of millions.

What is an ORV? ORV's include motorcycles, four-wheel drive vehicles, all-terrain vehicles, trail-bikes, sand-buggies, snowmobiles, or any other mechanical contraption capable of traversing unroaded terrain. Even typical highway vehicles may sometimes be counted as ORV's. At times it seems as if all of nature's diverse landscapes will inevitably result in the presence of an ORV.

How many ORV's are there? We really don't know. However, a recent survey by the Heritage Conservation and Recreation Service suggests 40 million or so, including about 14 million snowmobilers. Naturally, snowmobile use is focused in the northern tier of states--especially in the upper Midwest--and in other regions having an adequate season-long snow cover. ORV's other than snowmobiles occur nearly everywhere, but the Intermountain and Pacific Northwest regions record the highest rates of participation. Of course, concentrations of specific kinds of ORV's vary locally. In mountainous regions, the manager may be confronted with high proportions of four-wheel drive units. In the sandy and coastal locales of the Southwest, one may deal with variations of sand and dune buggies.

To discuss visual impacts resulting from ORV use, one must first attempt to understand the nature of the activity. Observing the behavior of ORV participants, one quickly sees that there are really several sets of activities associated with ORV's. Each has its own requirements for space, environmental settings, and social interaction; each has its unique visual and resource impacts; each has differing functional and dysfunctional values. This diversity must be recognized in analyzing and mitigating visual impacts.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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ORV activity includes such aspects as competition, play, exploration, and group participation. At any given time and place, an ORV participant may hold differing levels of these orientations, thus affecting the participants' behavior, and consequently impacts on the resource and conflicts with other users.

Participants oriented toward competitive activity seek status and excitement. The user reaps benefits from interacting with other participants. Essential support activities include pit crews, competition administrators, information systems, health care, trophies, and so on. Much of the pre- and post-competition activity is centered on maintaining the machine and utilizing it as the attraction for social interaction.

ORV play involves somewhat random movement over the landscape with no specific destination, other than the landscape, in mind. The challenge of the environment, informal recognition of status, and social interaction may be the important values. The operating efficiency of the machine may not approach the same level of significance as in competition. Supplemental recreational activities such as camping, general play, and social interaction may be critical to a "quality" ORV experience.

To the individual using the ORV for exploration, the machine may be viewed principally as a means to an end. The ORV permits other kinds of recreational experiences. Status, excitement, and affiliation motives may be minimal. Appreciation of amenities and learning about nature may be more important expectations. Activities may include rockhounding, backcountry camping, exploring ghost towns and ancient Indian ruins.

A final dimension typlifying much snowmobile activity in the upper Midwest relates to the user's gregariousness. This activity is characterized by large numbers of individual snowmobilers gathering together (perhaps a club) and traveling from one rural taphouse to another. Activity occurs during the evening along linear pathways that may be very close to existing transportation corridors, or along abandoned logging trails.

The nature and extent of visual intrusions resulting from ORV operation is a function not only of the recreation experience but also of the site. The principal visual intrusion begins as a track or set of parallel lines imposed upon the vegetation or the surface of the soil. These lines may remain simply as lines, but with intensive use may evolve into ruts. The ruts appear, in some forms of ORV activity, as challenges to the participant, furthering use and impacts. One set of ruts in an intensive use area becomes several ruts. Many ruts used intensively may result in complete elimination of vegetation over a broad area.

Visual impacts from snowmobile operation are conceptually similar. The snowmobile lays down a track--a linearly compacted area--in the snow. The resulting track may attract more snowmobilers. Heavy snowmobile traffic will usually lead to the development of moguls on the trail which must either be groomed or avoide by the snowmobiler. Intensive use may result in trails 8- to 12-feet wide.

However, the arrangement of the impacts is again influenced by the experience participants seek. In a competitive cross-country race, tremendous, if temporary, volumes of dust are raised at the mass start. Further down the course the landscape impact of the event may be limited to a single track, which may not be visible to the casual observer. Competitive activities which impact the landscape may involve hill climbs and drag races as well as cross-country races. Each leaves a describable impact.

Contrasted to the linearly oriented impacts of a race are the broad effects of ORV play. Since movements are somewhat random, or even ordered such as in "follow-the-leader" and "tag" games, multitudes of tracks gradually mingle to impact a fairly wide area. Yet, many of these impacts appear to be focused along a corridor that is determined by accessibility and spectator visibility.

In some areas, a snowmobiler also engages in play. In these places, there may be many tracks spread over a broad area. The imprint of the snowmobile may not be as obtrusive as other ORVs--unless one is a cross-country skier. Snowmobile use represents a visual, audible, and functional disruption to this group of wildland visitors. Of course, the saving factor for wildland managers is the snowstorm. If a snowfall does not completely obliterate a track, it will often soften the disrupting abruptness of the impression.

Finally, in ORV exploration, impacts again are concentrated in a linear corridor. In mountainous regions much of this activity actually occurs on roads, trails, or right-of-ways originally constructed for logging, grazi mineral extraction, or some other purpose. Thus, ORVs are impacting an already impacted area.

It is worth noting some behavior which extends the initial impacts of ORVs. In some competitive situations, spectators will return to the site of a cross-country race the following weekend to see if they can successfully complete the course without the competitive pressure.

Spectators impact the landscape another way, too. Often, during a cross-country race, there are times of little competitive activity Spectators, having nothing else to do, may dri their machines at random, increasing visual impacts.

Pit areas and informal camping grounds are often associated with competitive events. The confused, unorganized conglomeration of vehicles results in another type of visual impact. The color and texture of campers and spectator vehicles are not congruent with the natural, free-flowing landscape they are imposed upon.

Visual impacts are not necessarily limited to on-site activities or even during the same time period. These scenes indicate off-site visual impacts resulting from nearby ORV activity.

The intensity of ORV visual impact varies according to use levels, type of vehicle, operation of vehicle, soil, aspect, vegetation characteristics, and season of use. Often, in arid climates, direct effects of ORV activity are compounded by wind erosion and accelerated runoff due to the reduction of soil holding vegetation. And, there may be a critical point in use levels beyond which such a compounding effect occurs. We can predict some impacts: Four-wheel drive vehicles visually disrupt an area more than three times more quickly than motorcycles. Wet season operation in some locales is a high impact period, regardless of the activity. Visual impacts on sand dunes may be obliterated by an overnight breeze while the visual intrusions left by the same vehicle in a nearby pinion-juniper stand may last endlessly. We've all heard the example of how the tracks laid down by General Patton's WWII maneuvers in the Southern California desert are still visible 30 years later. The careful observer can see traces of the Donner Party's fateful trek across the Great Salt Lake 130 years ago. Generally speaking, visual impacts last the longest in extreme environments and are self-mitigating relatively quickly in more mesic climates.

Two major decisions confront the visual resource manager. First there is a siting decision, i.e., where should ORV activity be located. Beyond the very specific criteria defined in Presidential Executive Orders 11644 and 11989, the following are suggested criteria: type of experience, resource capability, visibility, residence of users, management costs, edge, and previous disturbance.

The second decision concerns mitigation and rehabilitation. Essentially the manager is confronted with the "how-to" aspect of mitigating impacts after they occur and rehabilitating the site. In some areas, simple closure of the site is an acceptable and effective device, as shown in these scenes. In other situations, closures must be accompanied by additional measures such as seeding, fertilization, and watering. And in some areas even more intensive measures, such as landscape modification (terracing, filling) may be required to prevent further degradation after cessation of ORV activity. Such programs can be successful. Several years ago, a once heavily used ORV site in western Montana showed the effects of several mitigating measure: closure, seeding and landscape modification. Eighteen months later the once noticeable visual intrusion had all but disappeared. Finally, we may have to accept permanent irreversible disruption in many places such as the disturbance of desert intaglios which has already occurred or where economic feasibility of mitigation is prohibitive.

These considerations raise two major issues in a discussion of visual impacts. First, what is a visual impact? Is a single set of tracks across a meadow a visual disruption? We might all agree that a large area devoid of vegetation is an impact. The essential question is: where does one draw the line? Second, if an impact is defined as a culturally induced change from the natural landscape condition, are the visual impacts left by ORV's negative or positive? I'm sure environmentalists would argue that such impacts are a detriment to the natural scheme of things. They would argue that man ought to engage in low-impact activity; they might even argue that ORV's ought to be banned because of their visual and ecological consequences.

To the ORV enthusiast, however, such tracks and bared surfaces may actually be an attraction and viewed in a positive sense. The motorcyclist may see a track up the hill as the trail to follow; to the sand buggy driver, the pair of tracks ending halfway up a steep dune or hill may suggest a challenge that must be met. The ORV enthusiast may argue that many visual impacts are simply that and do not significantly impair the environment. They may argue that the traces left by their activity are no more significant than the disruption resulting from silviculture, mineral extraction, or energy production. They may even agree that such impacts are a cost, but they will point to the recreational benefits received by millions of participants.

Of course, the visual impacts left by ORV's are only one part of the ORV issue. As you all well know, ORV's have become one of the most controversial wildland recreation activities in the country.

Visual impacts interact with other considerations. First, many opposed to ORV's are opposed on the basis of the values that ORV's represent: high-impact hard technology. Second, ORV's produce noise--the absolute amount of which varies, obviously--which is often disruptive of other recreation experiences. Third, ORV's conflict with many types of self-propelled activities such as hiking and ski-touring. In fact, ORV management may be the most complex recreation management task facing wildland administrators, with literally hundreds of issues needing to be addressed at the national level.

The visual resource challenge is a great one. We need to:

1. inventory how much area is being disrupted on a national scale;
2. project future levels of participation;
3. identify the different kinds of ORV experiences;
4. assess the characteristics of ORV sites for different experiences;
5. develop environmental and landscape impact monitoring approaches and technologies;
6. initiate a systematic research program focusing on the above and other high priority issues.

Mitigating the visual impacts of off-road recreation vehicle use probably will not eliminate the controversy centering on this land use, but it may go a long way in providing Americans with a more visually appealing landscape.

Technology Available to Solve Landscape Problems

Descriptive Approaches to Landscape Analysis[1]

R. Burton Litton, Jr.[2]

Abstract: Descriptive landscape analyses include various procedures used to document visual/scenic resources. Historic and regional examples of landscape description represent desirable insight for contemporary professional inventory work. Routed and areal landscape inventories are discussed as basic tools. From them, qualitative and quantitative evaluations can be developed although certain landscape attributes are omitted. Aesthetic evaluations and visual impact predictions for environmental impact studies can originate from landscape analyses. Scope and implications of needed research in visual landscape studies are discussed. Finally, landscape planning goals and landscape design policies are outlined as visual quality controls. The professional role of landscape architects and environmental planners is stressed in the paper.

INTRODUCTION

Landscape analysis is the broad, sometimes fuzzy field which includes a set of different activities all concerned with visual resources. Included are inventories of physical-visual elements and their relationships, qualitative or quantitative evaluations (or assessments), landscape aesthetics reports for environmental impact studies, visual impact predictions, and the identification of planning and design goals as related to the landscape. In this paper, emphasis is in descriptive approaches and the professional roles that may be assumed by the landscape architect or environmental planner in visual analysis. Yet it is clear that many different professionals and academic disciplines have related interests in landscape analysis and aesthetic quality of the outdoor environment; their perceptions and capabilities are needed.

LANDSCAPE DESCRIPTION: SOME HISTORIC BACKGROUNDS

It is ignorant to think that landscape architects have created descriptive landscape analysis in the last decade. There is a rich store of landscape descriptions from the past as well as the present. It comes from varied sources, but it can be useful to us in developing contemporary methods of visual analysis applied to landscape planning and design.

While the characteristics of landscape description may be as varied as different authors' purposes, that variation can suggest how complex landscape perception may be. Pragmatically, it is instructive to examine the language used in narrative accounts of landscape and to be aware of what artists such as Catlin and Moran have done. The field observations of others can improve our astuteness in the field. We should be acquainted with cultural or historic perspectives that landscape descriptions can carry and appreciate the potential usefulness of portrayals made at a particular point in time. Landscape elements and their relationships seized upon for description by various observers may confirm some common threads of perception, giving us guidance in selection of what to include in an inventory.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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Descriptions may take a turn toward evaluation. To avoid confusion, it is important to differentiate between direct description and the appearance of personal or professional values attached to the outdoor environment. What has been written or graphically represented can give clues about valued aspects that others have held from seeing the landscape; this is information useful in broadening our perspective on visual values.

Especially in the accounts of scientists and naturalists, there may be insight on how appreciation of the landscape may be linked to natural processes--how environmental factors may have ties to the nebulous world of landscape aesthetics.

A few personal selections of landscape descriptive examples follow. Some are contemporary. Some are from recent history. They represent diverse samples rather than any attempt to be comprehensive. They represent different relationships with the landscape, whether seeking its protection, fitting it into a life philosophy, using it as a background to a set of activities, making man-made changes compatible with it or simply enjoying it.

Sir Humphrey Repton, 18th century landscape gardener

Repton wrote more than 50 "Red Books." Each was a landscape description of an individual estate--its terrain, water bodies, and plant cover. Included were the "improvements" which he proposed. To help the client's visualization of improvements, Sir Humphrey introduced the device of slides--a simulation of "before and after landscapes."

His descriptive language was simple and direct--to this he adds:

> My habit of landscape sketching I have considerably improved by practice and this may be of great use in showing effects where descriptions are not sufficient. (Repton 1792, v.2)

Henry David Thoreau, 19th century philosopher-naturalist

Thoreau's year spent at Walden Pond is a philosophic connection between man, universe, and the landscape at hand. The philosophy is part Emerson, part Thoreau, but the graphic description of landscape is purely that of Thoreau the Naturalist. He says:

> The scenery of Walden is on a humble scale, and, though beautiful, does not approach grandeur, nor can it much concern one who has not frequented it or lived on its shore; yet this pond is remarkable for its depth and purity...It is a clear and deep green well, a half mile long and a mile and three quarters in circumference...The surrounding hills rise abruptly from the water to the height of forty to eighty feet...They are exclusively woodland. All our Concord waters have two colors at least; one where viewed at a distance and another, more proper, close at hand. (p. 121) [Later the philosopher says] A lake is the landscape's most beautiful and expressive feature. It is the earth's eye; looking into which the beholder measures the depth of his own nature. (Thoreau 1960, p. 128)

William H. Brewer, 19th century botanist, agricultural scientist

For the period 1860-1864, William Brewer was the resourceful and diplomatic field director of the Whitney Geologic Survey of California. Traveling up and down the state for four years, living virtually all those years out in the open landscape, Brewer describes succinctly what he saw. He discards hearsay. First and foremost a scientist, he measured topography, took temperature records, geological and botanical specimens. He suffered from bad water, fought mosquitos and weather, and plowed his way through chaparral. In 1861, Brewer was in the Santa Cruz Mountains and said:

> Around us was the sea of mountains, every billow a mountain; deep dark canyons thread them, the form and topography very complicated, the geological structure very broken. Redwood forests darken the canyons on the west toward the sea, chaparral covers the ridge on the east. (Brewer 1966, p. 155)

Clarence E. Dutton, 19th century geologist, U.S. Army

Shortly after Major John Powell successfully explored the Colorado River, Clarence Dutton went to the Grand Canyon area to study its geologic history--"Erosion on a grand scale."--he says. He was accompanied by William Holmes whose extraordinary ink drawings of the Grand Canyon remain classics.

Through his description Dutton takes us on a trip across the Kanab Desert, the Kaibab Plateau and--"to the brink of the chasm, where we may contemplate its sublimity." There is accuracy of observation combined with scenic experience. The journey is a set of successive, linked encounters with varied landscape. He relates:

> When viewed from a distance, (the Kaibab) summit, projected against the sky, looks remarkably smooth and level...when we actually visit the plateau we actually find (it)...to be really very rugged....Over the Permian terrace the Kaibab is in full view...The light of the declining sun is upon it and the larger details stand forth in clear relief, displaying the openings of grand ravines and the massive faces of the intervening pediments.

Further on Dutton says:

> The desert before us is...(like)...the rolling prairie of Iowa but the range of vision is vastly greater....In the prairie the curvature of the earth soon carries the surface out of sight....
> (Here) we are constantly looking across a very wide but shallow depression--the earth's surface is here slightly concave instead of convex. [Toward the end of the day's journey, Dutton writes] As the sun nears the horizon, the desert scenery becomes exquisitely beautiful. The deep rich hues of the Permian, the intense red of the Vermillian Cliffs, the lustrous white of the distant Jurassic headlands are greatly heightened in tone and seem self-luminous. But more than all, the flood of purple and blue which is in the very air, (bathes) not only the naked rock faces but even the obscurely tinted fronts of the Kaibab and the pale brown of the desert surface... (Dutton 1882, p. 122-125)

Several more days of travel take us to the edge of the canyon. Dutton has provided a remarkable clear and graphic description of a remarkably rich landscape.

Aldo Leopold, 20th century forester, ecologist, game management biologist

One of the originators of wilderness in Forest Service lands, Aldo Leopold is intimately associated with the beginnings of American game management and the concepts of a land ethic--land use which is--"ethically and aesthetically right." Pithy critic of professors and short sighted practices leading to degradation of resources, he saw the ecological and aesthetic values of an unfragmented landscape. Gifted in his ability to describe the wholeness of landscape, he weaves together the feel of weather, the edge of stream and willow grove, the presence of animals--including his hunting dog --the sound of geese. Of a Wisconsin marsh Leopold says:

> A dawn wind stirs on the great marsh. With almost imperceptible slowness it rolls a bank of fog across the wide morass. Like the white ghost of a glacier the mists advance, riding over phalanxes of tamarack, sliding across bog meadows heavy with dew. A single silence hangs from horizon to horizon.
>
> Out of some far recess is the sky a tinkling of little bells falls soft upon the listening land. Then again silence. Now comes a baying of some sweet-throated hound, soon the clamor of a responding pack. Then a far clear blast of hunting horns, out of the sky into the fog.
>
> ...at last a glint of sun reveals the approach of a great echelon of birds. On motionless wing they emerge from the lifting mists, sweep a final arc of sky, and settle in clangorous descending spirals to their feeding grounds. A new day has begun on the crane marsh. (Leopold 1949, p. 95)

Sigurd F. Olson, 20th century ecologist, wilderness advocate

Biologist, north country guide, and steadfast spokesman for wilderness, Sigurd Olson expresses a philosophy reminiscent of Emerson and Thoreau, a scientific curiosity in league with that of Leopold, of Loren Eisley and Henry Beston. With long years of outdoor experience on the Quetico-Superior lakes, the backcountry of Canada and Alaska, Olson speaks knowingly of remoteness, the changing faces of the season, the loon's call in a moonlit night, an awareness of what is going wrong in the environment. For him, aesthetics of the landscape is a complex fabric of sight, sound, knowledge, time, and ethics. Turning to observation, he says:

> Swamps are particularly beautiful to me, for in them, I know, is true wilderness. I like them in spring when they are alive with redwinged blackbirds...when black ducks explode around every bend in

> wild confusion as they climb for the sky. I appreciate them in the fall when heathers become coppery and even the spagnum is full of color, and the pitcher plants stand bold and tall as they change from summer's green to red. (Olson 1976, p. 85)

The foregoing examples of landscape description represent a variety of purposes. But from them we may develop better contemporary descriptions for application to landscape analysis and land planning.

DESCRIPTIVE VISUAL INVENTORIES

Landscape inventories, based upon description, are rational documentations of observed landscape. They are the foundation for succeeding assessment and analytical interpretation. They are not assessments. Professionally prepared, they need to be objective representations of the landscape at a known point in time. What does objectivity mean in this instance? It means that base line information is provided, that the landscape is represented in a straightforward way as it may be seen, not as it may be judged to have particular values. It means that the inventory elements and criteria are clearly identified. Brewer's means of describing landscape may be useful here--he used simple unbiased language that provide clear images.

An objective inventory further means the observer identifies typical landform, vegetation, water, and land use elements that are characteristic for a study area. Visual patterns and relationships among these four elements are most important to identify. These may be represented from sampling and portrayed through photographs and drawings. It is not a visual inventory if it does not have graphic representation. Most landscapes will also have some atypical elements, such as landforms of unusual contour or scale, cascades of fast water, or coves of old, mature trees; these are the more distinctive things easiest to identify and record. While graphic examples represent what both typical and atypical parts of the landscape look like, a map and descriptive narrative give coordination to the inventory. Another way for the professional to maintain objectivity is to consider that the integrity of the typical or ordinary landscape combined with the atypical or extraordinary landscape is necessary to maintain overall scenic quality. The protection of only special or unusually scenic places --what ever they may be--would be to make the landscape a museum piece.

Descriptive inventories may be divided into two classes: routed and areal. The routed inventory uses a road, trail or stream as the location of a traveling observer, limiting attention to the landscape within the visual corridor. The visual corridor is the bounded area visible to the observer; it includes invisible pockets. In hilly or mountainous terrain, the routed inventory tends to have a restricted corridor in which intensive detail may be recorded. For example, the 15-mile inventory between Shaver and Huntington Lakes, Sierra National Forest, California, (Litton 1968) includes 37,500 acres in the visual corridor but three-fourths of that seen area is less than 3 miles from that road. Areal inventories may be of any scale or extent, hence they may contain detail varied to suit either broad planning purposes or those of intensive design. In three examples of area inventories, a Lake Tahoe study covers the 315 square miles of the lake watershed, a British Columbia study is of 10,000 square miles, and a Northern Great Plains visual study samples the landscapes within a 235,000-square-mile area. It is important to note that each of the area examples above are subdivided into subordinate parts or units.

Any inventory, routed or areal, becomes more useful and more representative of landscape variations if it is divided into visual units. Definitions of units depend upon spatial characteristics of land forms and vegetation or upon presence of a visually consistant (or homogeneous) set of elements. In an intensive research project combining landscape design, plant ecology, and silvicultural objectives,[3] 200 acres of forested roadside are being manipulated and studied along 3 miles of highway; landscape units of the study consist of nine visual reaches or spatial segments of the road and its roadside. The Lake Tahoe inventory (Litton 1971) is built upon terrain enclosures with side spurs and cohesive skylines, upon conspicuous peaks or lake features, and upon distinctive or consistant vegetation mosaics; there are 20 visual units which vary in size from 4 to 40 square miles. The British Columbia visual resources study contains 125 units which are topographic enclosures "Each with its own distinct visual character and degree of unity." (Tetlow and Sheppard 1977, p. 9), and in size they range from 12 to 275 square miles.

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[3] McDonald, Philip M. and R. Burton Litton, Jr. 1976. Landscape Management - Silvicultural Prescription for Enhancing the Scenic View from a Highway in the Mixed-Conifer Forest Type. (Study Plan Title) Pacific Southwest Forest & Range Exp. Stn., Berkeley, Calif. Project now in progress on the Plumas Nat. Forest.

The Northern Great Plains study (Litton and Tetlow 1979) proposes a conceptual set of four different kinds of visual units. Two of them, called "continuities" and "provinces," are broad and generalized, use repetition of consistant landforms, water, vegetation and land use patterns for identification, and cover hundreds to thousands of square miles. The other two, called "units" and "settings," are based upon topographic enclosures and other landscape features; they cover a few to tens of square miles per unit.

LANDSCAPE EVALUATIONS

Two kinds of evaluations may follow the visual inventory. They are professional judgments by landscape architects and environmental planners and the summation of preferences expressed by interested citizens, making use of public participation procedures. In both situations, simpler visual values (or relationships) are usually substituted for fuller and more complex aesthetic values. Yet it is very questionable that visual and aesthetic values can ever be entirely separated from one another. This question about the nature of values poses one of the most fundamental dilemmas of landscape assessment.

Criteria used in professional evaluation are fundamentally derived from design, aesthetics, and observational perception. The Visual Management System (USFS 1974) and the Visual Resource Management guides (USBLM 1976) both name line, form, color, and texture as criteria; but then they are exemplified by occurrences and relationships found in nature. My preference has been to use the aesthetic criteria of unity, vividness, and variety (1972), but I have tried to lend reality to these through interpretations of how they may exist in the landscape. It is absolutely essential that these abstract terms and others[4] not remain esoteric and that they be expressed in tangible ways expressive of landscape values. Otherwise the visual assessment is not made intelligible to the reader. The abstract concepts of form, space, and color need, then, to be tied to landforms, vegetation, water, and land use patterns--the basic physical elements of visual landscape.

It is unfortunately true that visual assessments are prone to omit values that may be attributed to dynamics of the landscape. These are the long and short term changes of visual image (and of aesthetic impact) due to factors such as season, weather, animal life, or vegetation's successional progression. Descriptive literature suggests that seasonal aspects of landscape or its apparent modification by weather and light may indeed make the most indelible impressions upon the observer. Reference to the "ephemeral landscape" has been a personal attempt to recognize this idea (Litton 1968). Additionally, the sequential movement of an observer through the landscape, both in time and space, may profoundly alter a person's sense of scenic values. The reasons for omitting these several things from evaluations are simple enough. We do not know how to do it; or prospects for agreement are poor. Here is another set of interesting dilemmas about landscape evaluation.

Definition of visual inventory units, within the context of a regional landscape ("character type," "characteristic landscape," USFS 1974, p. 5-7) not only improves the inventory, but it is essential in making comparative qualitative assessments among units. It assures that systematic application of adopted criteria is applied to all area subdivisions. Visual sub-units have a greater tangibility than do a whole study area, especially if the area is large. Overall evaluation is more logically developed as a sum from tangible parts than emerging full blown from a total study area.

Qualitative and quantitative evaluations need comment. Professional evaluations are primarily qualitative even if quantitative means of assessment are applied. Qualitative judgments normally express the results of using criteria which are not themselves readily reduced to simple or precise numerical values. Quantitative procedures, particularly applied to different visual units, can systematically measure such things as relative relief, mosaic unit areas of various vegetation types, or numbers and coverage of water bodies. The results of such measurements are most useful in drawing systematic comparisons among differing components in different units; their rankings as to visual value still call for qualitative judgment.

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[4] Line is also edge, contour or silhouette. Form includes space and shape. Color includes hue or chroma, brilliance and value. Texture is but one part of surface variance and patterns. Then there are relationships of scale-proportion-relative size, of dominance and subordination, of unity-harmony-discord, of richness-diversity-variety, of vividness-imageability-novelty, of contrast and of repetition, etc.

The use of arbitrary (or relative) numbers to represent visual/aesthetic criteria is common and useful. Assumed numerical values do not produce quantitative evaluations and they should not be so termed. They do (or should) produce comparative evaluations. Arbitrary numbers are merely labels which are no better than the criteria they represent or the reliability with which they are used. Where such numbers are weighted or multiplied, as opposed to being simply summed, they are especially apt to go astray.

The Northeast Coal Study Area of British Columbia (Tetlow and Sheppard 1977) is a good example of using relative ranking numbers to draw careful, methodic scenic comparisons among a large number of units. Their criteria are well identified, conceived in the context of the region, and final rankings are the result of professional judgment. The criteria and their representative numbers are used only by the professionals involved--the question of unreliability due to application by a different set of judges is avoided.

Community participation in identification of perceived values of landscape requires psychological or sociological analysis. Because of conflicting political views and administrative/legal restrictions, it is virtually impossible for public agencies to conduct social response studies on public land. As a consequence, most of this kind of insight must come from academic research; it is a restricted endeavor. Workshops, such as conducted by the National Park Service (1978) or by professional consultants, are currently the most prevalent means of soliciting citizens' opinions and seeking their preferences. Preferences are, however, generalized judgments; and include a complex of variables in which visual elements are elusive. It is more feasible to conduct workshops on management and design alternatives than it is for every problem of landscape quality evaluation.

Much work is needed to establish correlations between physical-visual landscape criteria used by professionals and perceptual values identified in public workshops or participatory testing. Reinforcement of visual analysis procedures would result as validity of criteria is cross-checked. It should be anticipated that participatory evaluations or research will reflect local values (Zube et al. 1974) which are not safely attributed to other regions. It is also a point of caution that participatory evaluations may change over time. Present opinions about landscape values should not eliminate choices to be expressed in the future.

After evaluations are made, whatever their origin, the question remains about what decisions are most appropriate for landscape units of different value. Where high quality is identified--and it is apt to be a rare thing--it is clear enough that special planning and design efforts are called for. But it would be an error to spend most of a planning-design-management budget to protect a relatively small piece of a large landscape. Because ordinary landscapes are regionally typical over broad sweeps of country, it seems most appropriate to put most of the planning and management effort into maintaining their kinds of visual integrity. Otherwise the landscape falls apart, losing overall aesthetic quality.

LANDSCAPE INVENTORIES FOR RESEARCH AND MONITORING

The professionally prepared landscape inventory, properly done, represents work of a qualified and experienced practitioner--an expert's product. This same inventory with its supporting elements may also be considered as hypothetical, being subject to examination for validity or additional research. Landscape concepts of inventory elements such as landform features or spatial enclosures (Litton 1972) were the subject of perceptual validation by psychologist Kenneth Craik (1972); results showed a high level of agreement between the visual perception of lay persons and that of the professional. In another example of psychological research directed toward landscape displays, visual relationships of elements found in the riparian environment of the Connecticut River Valley are the subjects of perceptual response and evaluation (Zube et al. 1974).

Combined research between the disciplines of plant ecology and landscape architecture was referred to earlier (McDonald and Litton). In this project, landscape prescriptions to manipulate the visual relationships within the roadside forest landscape are being combined with silvicultural techniques. The research could be called "recreational silviculture." Inventories of existing vegetation with sample plots and of visual landscape recorded the original conditions before either visual prescriptions or silvicultural treatments were developed. A "View Enhancement Plan" now represents the joint objectives. It is a detailed study along 3 miles of road. Being in the Sierra Nevada mixed conifer forest, the vegetative mosaic is complex. Already identified is a clear necessity for flexibility in how prescriptions may be altered or shifted for best compatibility to specific plant aggregations.

The landscape inventory with visual samples is a device for monitoring the appearance of natural and man-made change over time. Individual changes in the landscape may seem insignificant but their accumulation over time can be seriously degrading. No judgment about shifting changes in quality is possible without the visual base line of how the landscape looked at a specific time in the past.

This kind of record is also desirable for legal purposes where litigation seeks proof demonstrating a magnitude of degradation or loss of landscape values. Additionally, changes in visual character may provide initial clues that other less visible changes of environmental quality are taking place.

ENVIRONMENTAL IMPACT REPORTS AND VISUAL IMPACT PREDICTION

Environmental analyses and associated impact statements require consideration of landscape aesthetics. The National Environmental Policy Act of 1969 calls for "... esthetically and culturally pleasing surroundings." (Sec 101(b)2) and insuring that "... presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking..." (Sec 102(B)). State environmental acts somewhat similarly make this a responsibility. Even so, environmental analyses and impact statements *per se* have contributed unevenly to the improvement of amenity resource analysis. Reasons for this are several. The problem is esoteric, and frequently the aesthetics sections of EIS's are mediocre. Professional inadequacy is a frequent cause of poor performance or a low priority is given to the amenity section by those responsible for the preparation of the whole environmental report. Public response, however, suggests that the matter of scenic quality and amelioration of impacts is of significant concern (Gallup 1978). Where the subject of landscape amenity within an EIS is treated in superior fashion, the report is not often readily obtainable and drops out of sight when the immediate purposes of hearings and review are satisfied. The opportunity is lost for the substantial amenity report to contribute to improvement of the analytical process.

The aesthetics resource analysis of the Upper Susitna River, Alaska, part of an environmental report (Jones and Jones 1975), is thorough and excellent. It is built upon visual analysis. Four proposed dams and reservoirs are the sources of developmental impact. River landscape units are identified and comparative visual evaluations are made within and among units. Aesthetic values are equated to visual values and relationships. Four criteria are used. They are vividness (memorability), intactness (relative apparent naturalness), encroachment (presence of degradation), and uniqueness (relative scarcity). Conclusions include a comparison of the visual-aesthetic impacts of alternative planning proposals. In summary, the report is a good indication that the abstract generalities of environmental aesthetics can be logically and tangibly developed through the use of visual landscape analysis.

Visual impact predictions are the fit or misfit between development alternatives and the landscape's visual vulnerability--its relative sensitivity to degrading change. Results of visual impact investigation may take one of two forms. The points and places within the study area can be identified where greatest visual alteration is expected--a "red flag" procedure. Or impacts may be portrayed by visual simulation; graphic or photographic images are made to represent changes as they may be seen in the context of surrounding landscape.

In environmental impact studies, generalized planning or design choices, such as alternative highway corridors or dam sites, mean that visual impact predictions must be approximations made in the absence of specific design and construction details. When the impact source is known in principle rather than detail, using the concept of visual vulnerability and "red flagging" seems a sensible approach. In brief, visual vulnerability evaluation (Litton 1974) makes use of three categories of information. They are: identification of special landscape compositions and landscape units of higher quality, sensitive places and locations in the landscape, and inherent conditions and their surrounding influences. When landscape units have been qualitatively evaluated, protection of highly valued areas should be an obvious priority. Units of high visual quality may also include special compositions such as conspicuous "enclosed," "feature," or "focal" landscape types (Litton 1968 p. 26-35). Sensitive places and locations in the landscape include skylines, water edge zones, edges between contrasting vegetation types, open faces, and higher locations upon the terrain. Inherent conditions include factors such as steep topographic slopes, soil color contrasts, and degree of complexity of the vegetation mosaic. Surrounding influences include orientation affecting visibility and plant regeneration, climate, and differential responses to seasonal change. When visual vulnerability evaluation of visual impact is applied to a particular locality, criteria need to be modified to suit the circumstances.

Another way of considering relative visual impact is found in Jacob and Way's study of visual absorption capability (1969). Similar in some ways to the concept of visual vulnerability, visual absorption is the potential for developmental changes to be absorbed (or screened) by vegetation and topography. Set in the New England landscape, the relative visibility of typical houses is examined in the surroundings of young deciduous forest and low coastal hills.

Visual impact prediction carried to the level of visual simulation is possible when alternative design solutions are known in some detail and are applied to specific sites. One approach is to use landscape control points (Litton 1973). These are set viewing points from which a rather extensive landscape may be seen and from which drawings may be made to show proposed changes. Not only may the components of the proposal be altered to reflect different design solutions, but their visualization may be shown from several different control points. While this is a conventional device used by architects and landscape architects to show a client what proposed designs will look like, the idea can be applied to review by resource management, to professionals from different disciplines, or to public meetings to solicit the reactions of interested citizens. It is assumed that drawings will be reasonably accurate representations (in the sense of being professional and ethical). It is essential that several alternatives be prepared so that their display results in a useful interchange of positive and negative responses.

A much more sophisticated means of presenting alternative design solutions and their visual impacts is by use of the environmental simulator. One is in use at the College of Environmental Design, University of California, Berkeley, under the direction of Professor Donald Appleyard. In brief, a scale model of urban or rural landscape is made, including the modifications which represent a particular design solution, such as a freeway, park, or shopping center. Using a movie or video camera suspended from a carriage system, a movie is made from the viewing level of an automobile or a pedestrian, following any route desired. The degree of realism is remarkable, and the dynamic presentation simulates the way we normally see our surroundings. The simulator is a tool for basic research in perception. It has application to everyday design problems. Its visual products are being used to compare reality with simulation, lay perception with that of professionals, and also to present design proposals to public groups for their response. (Appleyard 1977)

VISUAL CONTROLS IN LANDSCAPE PLANNING AND DESIGN

It is unfortunate that environmental impact statements and attendant landscape analyses carry the implication of single project--short term use. In a longer term view of the landscape and sustaining its varied qualities, landscape inventories an assessments of region and locality are tool to affect visual controls in landscape planning and design. Through monitoring an revision, landscape analyses should keep u with the dynamics of change, whether thos of wildfire, insect infestation, or timbe harvesting. Similarly, visual control within resource planning and administratio should be subject to refinement as tim passes. Alteration of landscape policie should reflect better identification o priorities. In many respects we are onl beginning to recognize that the whole landscape is a scenic resource--not just th rare and spectacular. The procedures n being developed to protect the landscape a still crude. Improvement is needed.

Visual controls can be categorized a general goals within landscape planning a design policies within landscape desig The two are interdependant because there the chicken/egg relationship between pla ning at broader, regional scale and desi at smaller, local scale. One is not mo important than the other.

Landscape Planning Goals

General goals are the expressed intentions to protect the visual qualities of a regional landscape. To address the visual integrity of a large area means to account for the landscape management intentions within a set of identified sub-areas or units. Control goals may be defined through the degree of change allowable with the domination of natural characteristics at one end of the scale and man-made domination at the other end. Some years ago (1972) I suggested that the following list of terms could be used to express this idea:

Preservation
Protection/Retention/Maintenance
Alteration/Modification
Rehabilitation/Restoration
Degradation/Deterioration/Destruction

Such words adopted as goals mean nothing without further elaboration. It is essential that they be graphically expressed, using landscape displays representative of different regional landscapes and their subordinate, local units. Even graphic displays need explanation because the visual image may not carry the same message to all viewers. National Forest Service landscape management (1974) has adopted general goals patterned after the list above, calling them "visual quality objectives" (p. 28). Discretion has led to omission of "deterioration" and "destruction" as responsible goals even if experience shows that these conditions are easily enough obtained.

Landscape Design Policies

Design policies are built upon design solutions which appear visually most appropriate at specific sites within unit scale landscapes. All of the usual resource manipulations are the design subjects, including roads, power corridors, timber harvest, mining, vegetation type conversions, administrative centers, recreational facilities, mining, and water resources structures. Then there needs to be scrutiny of the visual interrelationships between individual site projects or manipulations and their adjacent neighbors within landscape units. In both space and over time, visual relationships need critical analysis if we are to improve visual management.

The landscape inventory/assessment again represents the physical components of the scenic environment. Tangibility of visual elements should be greatest at the site and unit scale. Compatible relationships between the visual components of the landscape and the components of site projects are then the source of design policies. Form, shape, space, color, line/edge, texture, mass and size are both landscape descriptors and design tools. Similarly such words as proportion, scale, pattern, location/dispersion, contrast, dominance/subordinance, weight/ balance, and repetition express relationships seen in the landscape and those created in various design projects. Dynamic and temporal changes also apply equally to landscape and effects of design. It is re-emphasized that the abstract words of design do need interpretation to describe and fit the context of the local landscape.

Design policy concepts--expressive of compatible relationships--may be suggested by combinations from the following illustrative list:

Proportional similarity
Pattern emulation
Color contrast limitation
Dominant line attitudes
Scale replication/compatibility/
  subordinance
Shape/edge types and linkages
Location/dispersion pattern
Recovery/temporal phases
Form and shape complements

In theory, design policies which promote either conspicuous or inconspicuous man-made changes can be equally satisfactory; both can have high visual quality. In present wildlands, the more acceptable model is the one with changes held subordinate to surrounding landscape. Eventually, judging from European models and anticipating a time when planning and design are improved, more dominant man-made changes should become more acceptable. Some of our wildlands will then have become akin to rural agricultural landscapes.

CONCLUSIONS

Descriptive landscape analysis is now serving a variety of purposes. Visual inventories and assessments, while in need of improvements by research, do contribute to environmental aesthetics, visual impact prediction, landscape planning goals, design policies, perceptual and other research. Landscape planning and management for the scenic resource is actively developing but will improve as experience and research provides improved foundations.

In summary, some ten major points of this paper may be emphasized.

Roots of landscape description especially relevant to visual inventories can be discovered in the literature of different geographic regions and of natural history.

Objectivity of landscape description and of related inventories is a professional responsibility. It rests upon astute field observation and straight-forward documentation of both typical and atypical landscape elements.

Landscape evaluations cannot be made without prior inventories. Evaluation criteria need to be clearly expressed and have to be tangibly related to the landscape being studied. Identification of visual units within an area assists the evaluation.

Quantitative landscape evaluations are frequently misnamed. Many visual elements and relationships can be measured and scaled, but resulting assessments are comparative rather than quantitative. Qualitative approaches are the norm for present landscape evaluations.

Preference evaluations of landscape quality expressive of public participation are extremely difficult to obtain for public lands. Expressions of preference also contain many hidden dimensions. Workshop procedures are successful in seeking public response to planning, design, and management alternatives.

Physical-visual landscape criteria used by landscape architects need to be correlated to perceptual values of an interested public. Values identified for a certain locale cannot be dependably attributed to other places. Perceptual values can also be expected to shift over time.

Descriptive visual inventories represent tools for several kinds of combined research in psychometrics, plant ecology, and resource management planning. Their use is not restricted to immediate problems of landscape planning.

Visual impact prediction, varying in degrees of generality or specificity, can be addressed through a variety of available techniques. Reliability of different prediction methods needs to be validated.

Visual analysis techniques provide a rational means of indicating aesthetic values within environmental impact studies. When such studies do contain a worthwhile treatment of aesthetics, they are not usually easy to obtain, meaning the loss or burial of potentially good analytical methods.

Descriptive landscape analyses have application to development of both general landscape planning goals and more detailed landscape design policies. Balance is needed since design and planning represent related parts of a single planning process.

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Computers and the Landscape[1]

Gary H. Elsner[2]

Abstract: Computers can analyze and help to plan the visual aspects of large wildland landscapes. This paper categorizes and explains current computer methods available. It also contains a futuristic dialogue between a landscape architect and a computer.

INTRODUCTION

Computers can do routine things, such as balance checkbooks, calculate transportation costs, and send you bills. How can a computer possibly assist in the challenging, esthetic area of landscape planning? This paper discusses the current role of computers in landscape planning and suggests possibilities for the future.

Size of the Job

If we consider that wildlands constitute 1.6 billion acres of the United States or approximately 66 percent of our land area, then it follows that landscape planning for this area is a big job. As we have heard from R. Burton Litton, the largest public land management agencies have recommended approaches for planning the large areas they administer. But the actual job of landscape analysis and planning usually is done by one or two people on each administrative unit. For the Forest Service this typically means that these people have the job of analyzing about a million acres of land. And for the Bureau of Land Management it typically means several million acres for one or two people. Other agencies, private industry, and States often have a job of equal or greater magnitude.

To illustrate the size of one million acres, assume the area is square. If you started on a walk to visit each acre and walked continuously at the rate of 4 miles per hour, it would take you 1 year, 1 month and 17 days.

ROLE OF COMPUTERS IN VISUAL LANDSCAPE ANALYSIS

The implication of the above discussion for landscape analysis is that any problem requiring an area to be consistently analyzed will usually require a lot of field work, or a lot of data collection, or both, and will result in masses of data. Often the field work can be minimized through wise sampling, but usually data on the visual properties must be maintained and analyzed to make tradeoffs with other uses. The result: a computer robot may be a helpful friend.

Consider an example of determining scenic complexity. The analyst suggests that several variables must be considered and that these variables working together, determine scenic complexity. Furthermore, he knows some specific sites--control points--that are highly complex and some that are uniform. A simple approach to analyzing the entire area would be to prepare a map for each of the basic variables and combine these in various ways until the resulting map produced complexity indices matchin those of the known control points.

Now consider how a computer can handl the mechanical and bookkeeping aspects o this job. Suppose a transect of known values has been determined and the basic variables for the transect and the remainder o the area have been mapped. The computer ma combine such variables as topographic complexity, vegetation complexity, and accessibility with different weightings until it reproduces the known transect. Then the computer can use the same formula to determine automatically the scenic complexity for the remainder of the 1 million acres and prepare maps of the entire area.

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Grid and Polygon Overlay Mapping

Computers can perform two types of overlay mapping. One general type is called grid mapping; another type is called polygon mapping. These types can be combined; for example, input data is in grid form and the printout appears as a line-drawn polygon map; or, data is input by digitizing polygons and the printout consists of overlays in grid form and polygon maps.

Overlay mapping is a valuable tool in dealing with the many variables involved in landscape analysis as well as in incorporating these results into the total job of land-use planning.

Psychometric and Social Science Analyses

Any type of observer-based analysis concerning landscape preferences will generate large amounts of basic data. Both questionnaire and interview approaches typically gather subjective data from several hundred people on from 10 to 100 points of investigation. For a typical study this will amount to from 1000 to more than 10,000 separate pieces of data to be considered. To save time, computers are used extensively in analyzing this data. The methods include factor analysis, Chi-square tests, and other approaches to testing hypotheses as well as an array of methods for summarizing the data and generalizing results.

In addition to the psychometric methods, computers are used extensively in many social science methods. The objectives of these studies range from testing a simple hypothesis to developing a complex prediction or simulation model of landscape preferences, enjoyment, or many other aspects of the landscape environment.

Seen Area Analyses

Because the "landscape" is often defined as that area which is visible, it is frequently necessary to prepare a map of the "seen areas." For a single proposed development the map simply shows from which areas the development could be seen or not seen. It is usually one irregular contiguous area around the proposed development site with seen area "islands" scattered about; for examples, mountain tops.

For more complex situations--for example, a proposed roadway or an aerial tram--the computer can determine the seen area from the multitude of points that comprise the route. The computer can easily overlay each of these separate analyses to produce an intensity map of seen areas, a map that is frequently referred to as a times-seen map. This more complicated analysis is particularly useful in deciding where to allocate the most design effort and where to locate landscape control points. It can also be used to help answer many more complex questions; for example, comparing one route with another on the basis of diversity of scenery and viewing (Travis and others 1975).

ROLE OF COMPUTERS IN VISUAL LANDSCAPE PORTRAYAL

Suppose a manager asks the landscape architect to show him how a proposed microwave relay station will appear from six developed campgrounds, four major intersections, three staging areas for hiking trails, and a planned residential area. The manager insists that he wants accurate portrayals. From some of the fourteen viewpoints only part of the relay station will be visible and from others it will be totally visible. It will always be a different apparent size, however, because each of the 14 viewing points is a different viewing distance from the proposed station. Available computer programs can determine visibility and prepare an accurate, scaled drawing of the relay station from each of the 14 points. The computer can easily repeat the process if a differently designed station is proposed later or if the location of the station has been shifted.

When developments, rehabilitations, or other activities are planned, managers and public often want to see how they will appear before they decide to take action. For the wildland situation we are usually talking about "simulating" a scene that may have a vista of 20 miles or more. At this distance both the earth's curvature and light refractions become significant problems in preparing an accurate portrayal. Computers can take these two variables into account automatically and can also automatically draw the correct relative size of the proposed change and determine what portions of the change will be visible.

Two computerized approaches are: (a) scenes drawn totally by computer, and (b) modifications only drawn by computer and overlaid on color photographs. Either approach typically requires considerable elapsed time in putting together all the data that represent the topography, the vegetation, and the planned modification, and making the first accurate picture. After the first picture has been made, it is usually easy and quick to change viewing locations or the design of the modification, or both, and produce additional simulated pictures. One often chooses to use a computerized portrayal technique when examining many views or many designs or when an area is subject to frequent developmental pressures of all types.

The approach of drawing the scene totally by computer has the ability to portray topography, vegetation, and modifications, but may need to have color added by an artist to make the scene appear realistic and not abstract. Using the computer to draw only the modification, and then overlaying and drawing the modification accurately on a color photograph, has the advantages of maintaining the accuracy of the computer rendition and the realistic qualities of the color photography.

The previous discussion has defined various roles for computers in the area of landscape planning. Specifically, the discussion has highlighted several categories within the areas of visual landscape analysis and portrayal (fig.1). All of the applications in this discussion are presently in use by a relatively small group of specialists and are available for use by a wider audience.

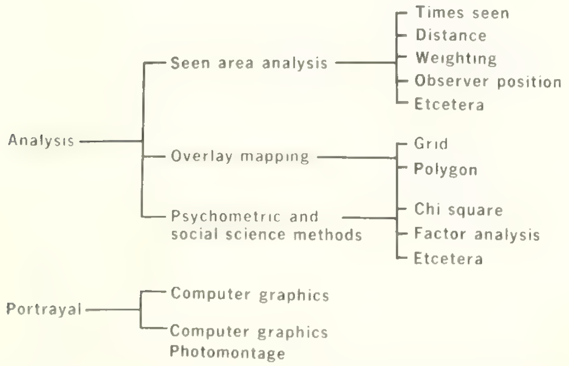

Figure 1--Computer applications in landscape planning

A FUTURE SCENARIO:
LANDSCAPE ARCHITECT AND COMPUTER DIALOGUE

I believe that the extent to which computers are used in landscape planning will increase dramatically in the next 5 years and that the usefulness will surpass most all of our current expectations. The following fictional dialogue between a future landscape architect and his friendly computer suggests several potential uses and implies priorities for research and development.

Landscape Architect: "What's the status of the landscape this morning?"

Computer: "Generally things are in pretty good shape. The blowdown we've been predicting for the last several days has occurred. Strong winds were accompaning the rainstorm we were having. It's over in both quadrants, 23F and 24F. The extent of the blowdown is about 30 acres. I detected it this morning about 12:35 a.m. from satellite reconnaissance. The visual impact of the blowdown does not seem to be too significant. I've calculated the visibility and it's not visible from any major road or any section of the trail system in the forest or any developed recreation area, or any areas planned for development in the next 10 years. Here's a draft of the paperwork for competitive bid on the salvage sale."

Landscape Architect: "Please change the minimum bid considered from 4 to 6 million dollars. Then please route this draft form electronically to the timber sale officer's CRT.

Were there any other major activities last night?"

Computer: "Local police radio reported a traffic accident on Highway 79 next to the campground area that resulted in damage to several small trees and moderate damage to one large tree. You may want to do a ground inspection of this area later in the day; it may be on the same route with inspection of the blowdown."

"After 1 a.m. there was no apparent action to the landscape within the forest boundaries so I automatically set my program to scan the incoming electronic mail. From this search it appears that we will receive a formal request for extending the highway. Later this morning they will propose crossing the northeast corner of the forest. I checked your Supervisor's schedule and he will not be available for a meeting until 10 a.m. I made a tentative appointment. I did some additional analyses for you to use in your position paper. I carried out a preliminary visual analysis of this proposal and found it will visually impact 23,000 acres of our highest scenic quality land with high frequencies of viewing, 15,000 acres of medium scenic quality land, and 17,000 acres of low scenic quality land.

Because I'm not equipped to interface with the proponent's data files, I had to calculate the construction costs myself. I estimate costs will be 42 million dollars."

andscape Architect: "Fine, but please heck your files and show me all proposed outes through this area, for any purpose, ver the last 10 years."

omputer: "Here are several past proposals. The closest to this alignment is the proposed expansion to the trail system. The expansion was not built because the results of our questionnaires showed that there was not sufficient potential traffic or public nterest to warrant building the trail."

andscape Architect: "Please provide a preliminary analysis of putting the highway on the trail system route."

omputer: "The cost of the highway going hrough the valleys, would be about 30 million dollars. This is a savings of 12 million dollars over the one that will be forally proposed later today. It would visally impact more medium scenic quality land ith high frequencies of viewing. But, it ould visually impact 16,000 acres less of ur dispersed recreation area. It would lso have an extremely good vantage point or a scenic overlook as it goes over the idge into the next valley.

I can calculate additional quantitative esults if, you desire. In addition to hese two alternatives, I'm sure that you ill be able to design modifications that ill be more attractive."

andscape Architect: "I will work on the odified design later today. In the meantime, please summarize the visual and econoc results for these two routes in graphic nd tabular form. Have this ready for viewing on the Supervisor's CRT by 10 a.m. toy. Please start a draft EIS and put these mmary results in the appropriate secons. Also, calculate and show me the nimum time route for visiting the blowwn, the campground, and the two alternave routes for the proposed highway. I'll ed to return here in time for the meeting ."

Key Scenario Points

The question is, what are the technological and institutional concerns embodied in this scenario?

- It assumes effective voice activation for input to computers.
- It assumes the operational development of dedicated minicomputers.
- It assumes that the costs of computers will continue to be less.
- In the matter of the blowdown, it assumes a monitoring system of the forest, either satellite based or ground based that is linked into a real-time computer system.
- It assumes in the matter of the police report, a verbal communication facility to the computer.
- It assumes the ability to analyze routes automatically in terms of scenic impact.
- It assumes the ability to recall previous statistics in the matter of projected recreational use for trail systems.
- It assumes limited capability of designing its own route for the highway system.
- It pinpoints those areas for which special design is absolutely necessary.
- It indicates that the costs of collecting new data will continue to be high, and that especially for socio-economic and preference data, it will be necessary to reuse previous data as much as is feasible.
- It predicts that objective data on the visual resource will become more and more important and that the public and managers will expect to see it in EIS documents.
- It predicts that administrative complexities will increase; for example, number of necessary forms and number of people concerned with visual resource decisions will increase; high level resource administrators will begin to use computerized robots to assist in coping with this problem.
- It predicts an increase in use pressures, of all types, for the land.
- It assumes that "man and machine" have developed a mature and satisfying relationship; this includes both management levels and analyst levels with computer robots.
- It assumes that "high-technology tools" will be used unevenly by both industry and government; that is, only where the value of the resource and the public demands warrant the expense.
- It assumes that many professionals will be trained equally well in landscape architecture and computer science; it further predicts that there will be an

increased demand for people with this balanced training.

- It assumes that the design profession will not be challenged by these computer robots; rather, the profession will be augmented with additional portrayal and analysis tools.

CONCLUSION:
"Growing" with Computers

The "extended family" concept of the future will undoubtedly include computers. For, like children--we decide to have them or not--and we decide on education (upgrading), health insurance (maintenance contracts), and we must deal with death or divorce, or both (trade-ins).

Meanwhile, we are going through a learning experience with this new technology, that is often frustrating. Not only are there queues for the use of computers but also are there dollar costs that we must be willing to pay and, indeed, the learning experience itself may be trying.

Whether computers will play a role in landscape management and planning is not an open question. They already are! The extent to which the role increases, however will depend on the number of tasks that we can innovatively assign to the computer and our ability to teach the computer to carry them out.

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Setting Technical Standards for Visual Assessment Procedures[1]

Kenneth H. Craik[2] and Nickolaus R. Feimer[3]

Abstract: Under the impetus of recent legislative and administrative mandates concerning analysis and management of the landscape, governmental agencies are being called upon to adopt or develop visual resource and impact assessment (VRIA) systems. A variety of techniques that combine methods of psychological assessment and landscape analysis to serve these purposes is being explored, especially in this country and Great Britain. A rapidly expanding body of research dealing more generally with conceptual and methodological issues in the use of observer-based descriptions and evaluations of landscape can also be identified. Given these trends, the time has arrived to address the matter of establishing technical standards for VRIA systems as a means of fostering and documenting increased levels of reliability, validity, generality and utility and moving towards procedures that are maximally useful and defensible. This developmental process is viewed in an institutional context from the perspective of socio-cultural evolution.

In the decade since the National Environmental Policy Act of 1969 called for methods and procedures "which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision-making along with economic and technical considerations," the visual impact of land uses upon the landscape has received attention in subsequent legislation, including the Coastal Zone Management Act of 1972, the National Forest Management Act of 1976, the Surface Mining Control and Reclamation Act of 1977 and the Clean Air Act Amendments of 1977, plus the various state-level versions of NEPA. In addition, administrative recognition of the importance of visual impacts can be found at the federal level, e.g., in the Department of Agriculture's Forest Service (USDA, Forest Service 1974, 1975, 1976), in the Department of the Interior's Bureau of Land Management (USDI, Bureau of Land Management 1975), in the Department of Transportation's Federal Highway Administration (Redding 1971; USDOT, Federal Highway Administration 1977), and in the Water Resources Council (U. S. Water Resources Council 1973).

During the same decade, the emergence of environmental psychology and related fields (Craik 1977, Stokols 1978) has contributed to our understanding of the factors involved in environmental perception and evaluation, particularly in the context of observer-based appraisals of scenic quality (Arthur, Daniel and Boster 1977; Craik and Zube 1976; Lowenthal 1978; Zube, Brush and Fabos 1975).

Especially in this country and in Great Britain, a vigorous and pertinent literature is being generated on the performance characteristics of techniques devised to describe landscape attributes and to appraise landscape quality. In this country, the work has been more or less directly influenced by the legislative and administrative mandates we have already noted. In Great Britain, these endeavors seem responsive to the evolution of the Town and Country Planning Acts and to the 'Countryside in 1970' conferences (Cherry 1974, Turner 1975). Similar undertakings are in evidence in other countries as well, such as Spain and Australia (e.g., Rodenas, Sancho-Royo and Gonzalez-Bernaldez 1972; Wright 1974) and at the international level in the UN Man and the Biosphere's Project 13: Perception of Environmental Quality (UNESCO 1973).

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Landscape description and evaluation emerge from an interaction between the human observer, on the one hand, and land form and land use, on the other. Thus, it is not surprising that this literature constitutes a joining of methods drawn from the fields of psychological assessment and landscape analysis. Within a relatively brief period, various techniques of visual resource and impact assessment have been introduced, applied and subjected to initial empirical and critical examination. In this country, one can note the techniques of Daniel (Daniel and Boster 1976; Daniel *et al*. 1975; Schroeder and Daniel in press); Jones (Jones *et al*. 1975); Leopold (Leopold 1969a, 1969b; Leopold and Marchand 1968; Hamill 1975); Litton (Litton 1968, 1972, 1974; Craik 1972); Peterson (Peterson and Neumann 1969; Kreimer 1977); Shafer (Shafer 1969; Shafer and Brush 1977; Shafer and Tooby 1973; Shafer, Hamilton and Schmidt 1969; Carlson 1977; Weinstein 1976; West 1969), and Zube (Zube 1974, 1976; Zube and Mills 1976; Zube, Pitt, and Anderson 1975). In Great Britain, the techniques of Fines (Fines 1968,1969; Brancher,1969), Linton (Linton 1968; Gilg 1975) and the University of Manchester Landscape Research Evaluation Project (Robinson *et al*. 1976; Tandy 1977) are noteworthy.

Any use of observer-based assessments of landscape in planning and management at the agency level raises a host of conceptual and methodological issues (Craik 1968, 1972; Craik and Zube 1976). First, the construct of landscape quality must be appropriately formulated and then validly captured by standard indices and methods of assessment. Second, decisions about monitoring operations for the purposes of resource inventory and impact assessment must inevitably address such issues as: 1) the selection of observers, 2) the instructional sets given to observers, 3) the levels of interjudge reliability to be required of landscape descriptions and evaluations, 4) the choice of on-site versus simulated presentations, and 5) the degree of generality of the results across populations of potential observers that is to be expected of the procedure. Third, organizational factors must be considered, such as 1) the training requirements for staff who make landscape descriptions and evaluations 2) conducting and communicating the landscape assessments in a fashion that maximizes their utility and influence within the decision-makin process, and 3) designing and managing an overall program of visual resource and impact assessment that fully responds to and adequatel implements the pertinent legislative and administrative mandates.

These matters are receiving active scrutiny both within this country (Brush 1976; Craik 1969, 1971, 1972b, 1975; Daniel 1976; Fabos 1971; Hart and Graham 1967; Kaplan 1975; Peterson 1976; Wohlwill 1976, 1978) and in Great Britain (Appleton 1976; Clamp 1976; Crofts 1975; Laurie 1975; Lowenthal 1978; Price 1976; Unwin 1975). In the United States, the participation of research psychologists in this enterprise is more evident; in Great Britain, a practical concern with effective incorporation of landscape evaluation techniques within the planning context is apparent in case studies of their application and commentary upon them (Blacksell and Gilg 1975; Brancher 1972; Dunn 1974; Murray 1962; Penning-Rowsell 1974, 1975; Penning-Rowsell and Hardy 1973; Turner 1975; Weddle 1969).

In 1975, a series of research workshops supported by the National Science Foundation was held at the University of Massachusetts in Amherst to examine issues in the use of observe-based assessments of environmental quality. A subsequent volume offers a systematic research agenda dealing with 1) the development of scientifically adequate observer appraisal systems for environmental quality; 2) a conceptual mode of the observer appraisal process, and 3) a conceptual model for application of observer appraisals of environmental quality within planning and management contexts; plus an array of thirty-one major recommendations (Craik and Zube 1976).

We might note that the notion of observer-based indices, or perceived environmental quality indices (PEQI's), is not limited to visual attributes. The construct of perceived environmental quality held by individuals can be thoroughly examined for specific domains of settings (e.g., residential environments, coastal zones) and then serves as a basis for devising indicators of the components of perceived environmental quality. Nevertheless, many currently used techniques entail the assumption that visual attributes are certainly an important facet of perceived environmental quality. In any case, appraising the technical adequacy of observer-based indices and the judgments they require proceeds in a similar fashion from the point of view of psychological assessment principles.

The Amherst workshops dealt with priorities for research; this Tahoe conference focuses upon matters of application. What kinds of observer-based assessments of landscape quality are required by the recent legislative and administrative mandates? What procedures have been and are being adopted by agencies whose responsibilities entail the analysis and management of visual resources? How can we gauge the scientific adequacy of current techniques and procedures and how can we nurture the evolution of procedures that are maximally useful and defensible?

At the outset, psychologists and other researchers contributing to these developments must acknowledge some genuine sympathy for the agencies involved and their staffs. The recent legislation is requiring significant innovation and alterations from customary practice. A wide variety of procedures can be anticipated as the various agencies seek to experiment with ways of incorporating visual resource and impact assessment within their operations. They must do so in the face of a lively interdisciplinary literature that is indeed pertinent but is both scattered and rapidly growing. It would not be difficult to list over 75 reference citations since 1970 that are essential reading for anyone having professional responsibility for devising, managing or operating a visual resource and impact assessment system. And, finally, although full evaluation of the on-going technical performance and adequacy of these systems entails the application of principles and methods of psychological assessment, staff expertise in these agencies has tended to fall primarily within the natural sciences and design disciplines.

Given these trends in the analysis and management of the landscape, the time has come to address the question of establishing technical standards for Visual Resource and Impact Assessment (VRIA) systems. In making an informed decision to adopt a VRIA system or to put into operational use a VRIA system developed in-house, agency staff must know what information it is appropriate to seek and require regarding performance characteristics and psychometric properties and must apply suitable criteria of psychological measurement in appraising VRIA systems.

In the field of psychological testing of individuals, explicit standards regarding the kinds of information that should be available about psychological assessment procedures when they are to be used in decision-making have evolved over the last twenty-five years (American Psychological Association 1974). In general, current standards establish the expectation that the manuals for aptitude and ability tests, interest measures, personality inventories and related procedures will provide information to potential users on administration and scoring, reliability, scales and norms, validity, and qualifications required of users. The detailed specification of types of information is graded in importance from essential to very desirable to desirable, with the essential recommendations reflecting professional and scientific consensus about what information is normally required for operational use of the assessment procedures. Specific forms of applied research are usually required to generate this information for each procedure. These standards for the technical manuals have been supplemented since 1933 by the Mental Measurements Yearbooks (e.g., Buros 1978), which provide critical reviews of psychological tests and procedures.

These APA standards have emerged gradually from extensive consultation with professionals and research scientists in the fields of psychological and educational testing, and the consensus about these technical requirements has evolved over the years. A similar developmental process can be expected regarding technical standards for visual resource and impact assessment systems. Clearly the next step is to expect that agency-level manuals will move beyond mere description of procedures and forms to include psychometric findings on reliability, validity, generalizability and utility.

Brief comment on these technical properties will reveal their practical significance for the use of landscape assessment procedures in decision-making contexts (Daniel 1976; Feimer, Craik, Smardon and Shepard 1979). The most basic property of any measurement instrument is its degree of reliability. Within this context, reliable visual resource and impact assessment requires substantial agreement among independent observers for the landscape constructs being monitored. Ample evidence exists in the research literature to demonstrate that landscape descriptions and evaluations can be dependably and consistently assessed and need not be arbitrary or whimsical. However, indices of inter-rater reliability and agreement should provide this empirical assurance for specific monitoring techniques. The validation of landscape assessment procedures takes several forms. For example, descriptive and evaluative dimensions should differentiate sensitively among landscape conditions, and assessments of simulated impacts should accurately forecast actual post-construction or post-transformation assessments. The generality of the reliability and validity indices for landscape assessment procedures must be gauged across the strikingly wide range of land form contexts and land use conditions that constitute the domain of land management policy and decision-making. Similarly, especially in light of the increasing requirement of attention to public participation, the generality of landscape assessment results across observer populations (including agency staff, interest groups and the general public) must be estimated and form part of the available information on the operating properties of visual resource and impact assessment techniques. Finally, the practical utility of an assessment system resides in the extent to which it usefully forms a part of the land management process and advances the institutional goal of responding adequately to legislative and administrative mandates.

We must recognize that despite legislative and administrative mandates to attend to observer-based appraisal of environmental quality, effective incorporation of these amenities and values into agency-level decision-making faces an array of understandable but formidable obstacles. We cannot allow technical standards set at premature or unrealistic levels to generate discouragement about the entire effort or to offer an excuse for dismissing these considerations out of hand. Instead, we require a perspective which shows that the specification and application of technical standards is a necessary and inevitable step in the maturation of effective visual resource and impact assessment procedures. Presumably, if there are mandates to incorporate visual resources and impacts within the land management process, then there follows just as strong an accompanying imperative that the job be done well and defensibly.

Perhaps the formulation of socio-cultural evolution recently offered by one of our psychological colleagues, Donald T. Campbell, will serve this purpose. Socio-cultural evolution is viewed by Campbell as an adaptive process, distinct from biological evolution but displaying parallel attributes, entailing variation and selective retention of societal and institutional forms, such as skills, customs, plans, designs, and procedures (Campbell 1965, 1969, 1975). When confronted with a challenge to its equilibrium, an effective society or societal entity emits a wide variety of efforts to cope with its new situation, embodying alterations, innovations and other deviations from customary practice. Consistent selection criteria are then applied to identify those new forms that display functional adaptation. Societal mechanisms come into play to retain the selected variants, such mechanisms as legitimacy, imitation and diffusion. Subsequently, additional mechanisms for the preservation and duplication of the selected variants are mobilized, including sanctions, policies, training programs and socialization into the new practices.

The loosely organized institution of land management in this country has been challenged to take account of landscape quality in a systematic fashion in its decision-making. As we have seen, a variety of applied techniques for visual resource and impact assessment has been generated and some forms are being tried out at the agency level. Several recommendations flow from Campbell's perspective on socio-cultural evolution.

1. The variation in types of visual resource and impact assessment procedures should not be prematurely curtailed. Indeed, new variants should be fostered for it is too soon to be convinced that the intent of the various legislative and administrative mandates has been fully captured by any of the present systems. A period of experimentation and openness to innovation and critical analysis is in order.

2. Although variation is to be fostered, consistent selection criteria should be specified and applied to sort out those variants that are reliable, valid generalizable, practical and useful from those that are not. This point has been our central message today.

3. Those VRIA systems that meet suitable standards must be retained, transmitted and continued in operation. This phase of the process will require training programs and continuing technical management of the VRIA systems. A new corps of technical experts, trained in both psychological assessment and landscape analysis will be required to serve this function.

Perhaps this last recommendation is the most alarming of all. The prospect of having to attend to visual impacts may itself be disconcerting, but having to welcome a new breed of environmental psychologists and landscape evaluators will surely be daunting to the Department of Agriculture, the Department of Energy, the Department of the Interior, the Department of Transportation, and other loci of federal land management and land use impacts.

Possibly the model that has emerged in the assessment and selection of high level managers and executives in industry will be appropriate. In many management assessment centers, staff psychologists operate the centers, provide training in the techniques, monitor and ensure adequate levels of reliability and predictive validity, conduct applied research, but do not themselves assess and judge the candidates; that function is served by managers already functioning in the institution who meet to observe the candidates (and potential peers) and to render their descriptions and evaluations (Dunnette 1971; MacKinnon 1975). In any case, the need for technically trained managers for visual resource and impact assessment systems possessing appropriate backgrounds in both psychological assessment and landscape analysis is compelling and perhaps even urgent.

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Technology Available to Solve Landscape Problems—Session A: Descriptive Approaches

Seeing Desert as Wilderness and as Landscape—An Exercise in Visual Thinking[1]

JOHN OPIE[2]

Abstract: Based on the components and program of VRVA (Visual Resources Values Assessment), a behavioral history of the visitor's perception of the American desert is examined. Emphasis is placed upon contrasts between traditional eastern "garden-park" viewpoints and contemporary desert scenery experiences. Special attention is given to the influence of John Wesley Powell's writings and the art of Georgia O'Keeffe. The specific region examined is Canyonlands.

One of the most important new commitments of contemporary society has been toward environmental quality. Landscape planning, assessment and impact statements have become decisive aspects of environmental preservation, conservation and development, based on the influence of public opinion, special interest groups, government agencies and legal statutes. These new circumstances have also meant an enormous growth in the need for information, more or less precise, about landscape aesthetics, including the visual resource. But such reports have often been of poor quality or limited usefulness, based upon outdated, irrelevant, or excessively narrow data. Major historic preconceptions which control landscape values are rarely considered. Analysis of written descriptions, illustrations, paintings and photography are rarely given much credibility. Contemporary viewpoints of scenic landscape by the general public are played down for the sake of professional evaluations which may miss the mark entirely. One difficulty is that aesthetic and value information is difficult to quantify. Another difficulty is the lack of significant normative guidelines and hence a lack of pragmatically useful information.

This is not the place to develop abstract theories of landscape values, or to review the extensive (and excellent) visual landscape assessment literature from England and the Continent. The task of this essay is to explore the essential historic, cultural, and social presuppositions of the modern traveller, tourist, or vacationer. The needs of permanent residents and the profit-motive of the businessman are another subject. Our attention is focussed on the visitor who experiences the desert, notably the Canyonlands region, as a temporary interlude intentionally different from his usual environs.

The following outline seeks to organize complex visual subjects into a manageable and interpreted framework. Nevertheless, in this reduction the landscape-observer interaction must not be ignored. Nor can the immeasureable and often-subjective nature of values assessment be denied. This outline is proposed to encourage further disciplined enquiry, analysis, criticism and review in order to shape a viable program for a visual resources values assessment.

PRELIMINARY OUTLINE

VISUAL RESOURCES VALUES ASSESSMENT:

A structural analysis of the visual experience of American landscape

Equation: Physical Environment + Behavioral Environment = Perceptual Environment

Behavioral Environment
  cultural tradition
  historical development
  natural history
  social patterns

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- technological innovations and limits
- information processing capability
- economic conditions
- political interfaces

- Physical Environment (components)
  - space/scale
  - observer position
  - form
  - climate
  - light
  - color
  - vegetation
  - wildlife
  - archaeological, historic, culture sites
  - existing human impact

- Physical Environment (dynamics)
  - dimensions
    - 2-D (picture plane)
    - 3-D (space perceived)
    - 4-D (observer motion in space)
  - sequence
    - vertical/horizontal
    - inner/outer
  - order/zone
    - panoramic
    - feature
    - enclosing
    - focal
    - detail

- Perceptual Environment (Physical + Behavioral)
  - controls
    - uniqueness
    - naturalness
    - environmental quality
    - land-use priorities
    - land-use compatibility
    - hazard level
    - limits on intrusions
    - controls on disruptions
  - impact framework (dialectical tensions)
    - nature/man
    - nature/culture
    - beauty/ugliness
    - aesthetics/economics
    - rarity/abundance
    - elitist/public
    - public/private
  - policy guidelines (management decisions)
    - project description
    - definition of clientele
    - accessibility
    - land-use activities
    - available technology
    - type and quality of intrusions
    - jurisdictional authority
    - fiscal resources
    - externalities

The unique desert of southern Utah and northern Arizona, notably Canyonlands, is used here as a sample region to explore VRVA as a useful framework. In other words, Canyonlands will act as an informal case study for the suitability of certain components for values assessment. To make the case study as productive as possible, two highly suggestive control exercises will not be abstract, but historic and concrete--traditional view of desert regions; and historic descriptions of American scenery which travellers find visually desireable, interesting, or aesthetically pleasing. Limits of space make the following narrative description highly selective and obviously incomplete.

NARRATIVE

Unlike most other geographic zones, the legendary image of desert is an environment utterly hostile to human settlement and development. This strong antipathy is not mere fable. Mankind emerged in subtropical regions, while a desert can be defined as an arid zone of high heat, intense sunlight and radiation, and low humidity, perhaps as little as six inches of rain a year. Summer temperatures reach 120°F and nights can be uncomfortably cold. Desert soils are often highly alkaline, not prone to agriculture even if water were available. Vegetation and animal life are more scarce than in humid regions. Giving little direct support for human life, deserts are known for their "terrible indifference to man" (Tetsuro 1943, Shepard 1967). There is a profound consciousness that "this wide extent of hopeless sterility" is a world not easily domesticated by man. It is among "the presently uncomfortable empty places," parts of the world literally off the map of any geography of human habitation. Psychologically, it was believed that entering the desert courted not only death, but also madness and the dissolution of one's being in a primeval chaos which was best left alone and unknown. What if, during the era of discovery, North America's Atlantic coast had been a desert? The physical and psychological problems of inland penetration and survival would have been insuperable.

American painters, who influenced so many of our notions of pleasant scenery, historically disliked desert regions. In 1835 the romantic landscapist Thomas Cole said every landscape without water was defective. A modern painter said it took him a long time to adjust his work to the desert: the land impressed him as vast, empty and paralyzing, with only four or five colors (Gussow n.d.). Georgia O'Keefe, master at evoking the sense of the desert, observed while "a flower touches every heart, a red hill in the Badlands, with the grass gone, doesn't" (O'Keeffe 1976). In contrast, the Canyonlands painter, Harold Bruder, a New England man, wrote in the 1960's: "I don't like New England. I don't like green mountains. I don't feel like painting them and I don't respond to green landscapes. I like desert, I like rocks, and I like the sense of the West. I can smell the air, feel the vast open sky....There are things you've got to go to the edge of--an abyss--and look in, and the thing opens up. What I try to get in the paintings is a quality of discovery" (Gussow n.d.).

To the earliest settlers and frontiersmen, the visual experience of the eastern United States presented a familiar and even friendly aspect. Like Europe, it was heavily-forested, with occasional open spaces, with natural entries through seacoast bays and river valleys, and with a temperate climate. For a millenium European civilization had been carved out of such an ecologically benign region. Biblical and classical traditions had already explained paradise in pastoral and agrarian terms (Glacken 1967). Later, in America, Crevecoeur and Jefferson would heap praises upon the yeoman farmer, identified as the typical American. He cleared out the wilderness, established the rural landscape, and ordered the land. Early travellers like William Bartram and Timothy Dwight informed Americans of the virtues of the domestic landscape. This would be turned into a visual aesthetic by transcendentalists like Emerson, Thoreau, Cole and Durand (Huth 1957, Conron 1974, Marx 1964).

Hence, in the early nineteenth century, when the American traveller began to visit his own land, he did not seek out rugged and uncleared places. The dominant biblical tradition told him that wilderness areas, notably desert regions, were places of primeval chaos. The cursed place, Sinai, had to be avoided and the promised land, Israel, entered. Desert was the dreaded zone of evil, meaninglessness and the victory of nature over man. Instead the early tourist looked for satisfaction in cultivated land, where man could be seen as "the immortal co-worker with God" (Shepard 1967). By the 1920's, the European visitor, Count Keyserling, described a Kansas landscape as near-perfect because it was the most fully-exploited place he had ever seen. The farmland of fabled Middle America stood out as the ideal visual image (Schmitt 1969).

The difference would not only be between loamy farmland and the western desert, but also between landscape and wilderness. Wilderness was defined as any place unhabitable, impenetrable, barren and unfarmable, such as ocean, forest, mountain and desert. Landscape was any place habitable, fruitful, civilized, arranged and shaped by man, such as an oasis-like meadow or pasture, symbolizing harmony, serenity and safety (Conron 1974, Stilgoe 1978).

These viewpoints involved a long visual history involving the simultaneous development of travel for pleasure, nature painting and the use of leisure time. Dutch painting in the seventeenth century portrayed the small, self-sufficient farm scene--a cluster of houses circled by fields and woodlots. This was a civilized space--a landscape--devoted to plowing, sowing, harvesting and husbandry. This would be followed by Gainsborough, Turner and eventually the French Impressionists (Shepard 1967). For most of American history, our artists were unabashedly nature-romantics, including Thomas Cole, Martin Johnson Heade, Frederick Edwin Church, Thomas Moran and the transplanted Albert Bierstadt. In 1905 the painter Worthington Whittredge (McShine 1976) wrote about the poverty of true landscape in America; we had too much wilderness. "I was in despair...The forest was mass of decaying logs and tangled brush wood, no peasants to pick up every vestige of fallen sticks to burn in their miserable huts, no well-ordered forests, nothing but the primitive woods with their solemn silence reigning everywhere" (fig. 1).*

The landscapes invented in these paintings, as well as popular travel narratives, taught the prospective tourist what he wanted to see, and where to see it. The tourist was encouraged by idealized paintings and topographical pictures to seek out the same picturesque materials in the landscape itself. This packaging of the visual experience may have reached a self-caricature with the picturesque, literally the scenery framed into pictures. William Gilpin turned Americans to a search for visual effects in pictorial places. These included rustic bridges, old oak trees, classic ruins, rugged rocks and the strong interplay of light and shade (Conron 1974).

The artist and writer, and after 1850 the photographer, selected significant details of the environment and out of them synthesized a highly-interpreted panorama. Looking at the desert and looking at a painting of the desert involved a feedback system, "a circle of constant comparison, discovery, and modification." The test of the traveller's vista was its success as a work of art. Today's traveller in his automobile comes upon the scenic turnout or viewpoint, already chosen for his benefit.

Eventually the barren desert did gain traveller's interest (Powell 1379). The route was somewhat circuitous. American vacationers soon sought novelty in their scenery. Natural historians like Bartram and Jefferson had already imagined a kind of wild garden, divinely maintained, in a forest or mountain valley. Paradise moved westward with the discovery of natural or wilderness parks. According to Gilpin, a park included scattered trees in a grassland lawn, with winding streams connecting alpine lakes (Conron 1974, Fine 1972). In Canyonlands today an oasis of green is called, significantly, Chesler Park. Soon interpreters made a distinction between the traditional eastern rural landscape and wilderness parks; the former were merely beautiful while the latter were sublime. Americans tested potentially sublime places by Burke's 1756 features: power, obscurity, privation, vastness, sense of infinity, difficulty of access and magnificence. Far-off untamed places, beginning with Niagara Falls and later with Yosemite and Yellowstone, became the new shrines of the American tourist; the parks blended together personal, national, historic, primitive and religious needs. A visit to a wilderness park made "marks on the mind" (Nash 1973, Worster 1977).

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*See color illustration on page 387.

Under these changing circumstances, curiosity arose about America's western desert regions. The traditional "forbidden ground" became visually accessible through paintings and narratives long before it was physically accessible to the public. The earlier image of a hostile zone was now covered over with an alternate biblical tradition of retreat into the desert for spiritual renewal. Desert became the "environment of revelation," the archetype of "sacred space" (Eliade 1957, Douglas 1973). Symbolizing purity and timelessness, the western desert became America's Holy Land. Today the landscape historian, John Brinkerhoff Jackson, describes "an existential landscape--without absolutes, without prototypes, devoted to change and mobility" for modern technological man. In contrast, Paul Shepard speaks of a multipath desert awareness, involving "power and omniscence of an ultimate and final presence," and "a sudden, aweful awareness of self in space and time" (Shepard 1967). In this light, zones of absolutes and prototypes as Americans search for certainty in a world of flux and change. In 1928 the painter John Marin wrote: "Seems to me the true artist must perforce go from time to time to the elemental big forms--Sky, Sea, Mountain, Plain,--...to sort of nature himself up, to recharge the battery. For these big forms have everything" (McShine 1976). And Robert Rosenblum in 1976 argued that the new generation of painters "would have to leave the realm of paint and canvas and move to the land itself, precisely to what is left of those remote, still pristine regions of Nevada, Arizona, Utah, or California, which for the 1960's and 1970's are the equivalent of the unspoiled American wilderness that inspired a Cole or a Church"(McShine 1976).

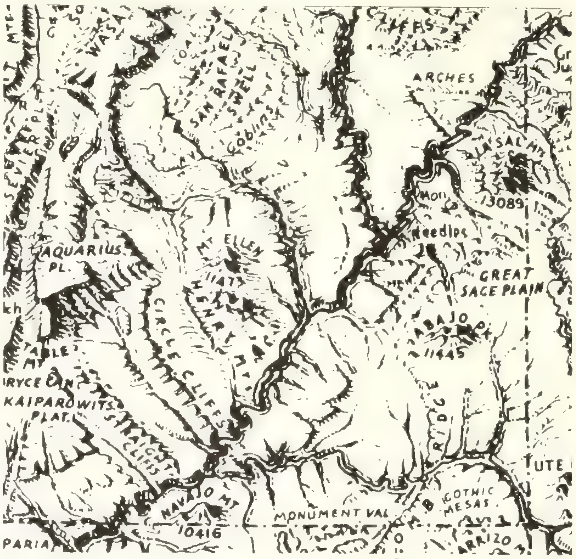

Figure 2--Physiographic map of Canyonlands (Reisz 1957)

Among the inaccessible desert regions of America, the least reachable until recently was Canyonlands, covering large areas of southeast Utah and northern Arizona. Even today a place called "the Maze" seems to defy investigation (Brooks 1964). The first reports heard in the east about this region were not favorable. By the 1830's the occasional trapper or trader spoke of mountains "heaped together in the greatest disorder," or he crossed the area but didn't find anything worthwhile to say (Huth 1957). But by 1858 a Lieutenant Ives, leading his expedition along the South Rim of the Grand Canyon, was captivated by the "strange sublimity of the region." He wrote of "wondering delight, surveying the stupendous formation...till the deep azure blue faded into light of cerulean tint that blended with the dome of the Heavens"(Huth 1957). Ive's words indicated clearly identifiable and sophisticated visual appreciation. John Wesley Powell provoked more interest by his remarkable journeys in 1871 down the Colorado River entirely through Canyonlands, and his equally spectacular reports in 1874 and 1875 to Scribner's Magazine (Stegner 1954). Powell's popularity depended upon his satisfying specific public expectations about natural beauty and scenic value, and his purple prose fulfilled these expectations. "Stand at some point on the brink of the Grand Canyon where you can overlook the river, and the details of the structure, the vast labyrinth of gorges of which it is composed, are scarcely noticed; the elements are lost in the grand effect, and a broad, deep, flaring gorge of many colors is seen. But stand down among these gorges and the landscape seems to be composed of huge vertical elements of wonderful form. Above, it is an open, sunny gorge; below, it is deep and gloomy. Above it is a chasm; below, it is a stairway from gloom to heaven: (Powell 1957, Conron 1974). The region was not physically accessible to the traveller until the Santa Fe railroad reached the South Rim in 1901 and the Union Pacific snaked into southern Utah in the 1920's (Hollon 1966). It can also be argued that Canyonlands came into its own as a visual experience with the invention of Kodachrome color film in the mid-1930's.

John Wesley Powell in particular used words to spin a visual web which even today dominates the visitor's perspective on the canyon region. He was unabashedly romantic and quasi-religious, portraying a mix of reality and unreality in the area (Krutch 1958). Powell's writings also epitomized the American traditional quest for concrete representations of ephemeral ideals. "The reflected heat from the glaring surface produces a curious motion of the atmosphere; little currents are generated, and the whole seems to be trembling and moving about in many directions....Plains, hills, and cliffs and distant mountains seem vaguely to be floating about in a trembling wave-rocked sea, and patches of landscape will seem to float away, and be lost, and then reappear" (Powell 1957, Conron 1974). Simultaneously, Thomas Moran's canvases incarnated Powell's prose (Figure 3*).

Later, in the 1960's, Eliot Porter's classic requiem for the dam-drowned region, The Place No One Knew: Glen Canyon on the Colorado (Porter 1967) would claim a similar perspective. This would be followed in 1971 by the text of Edward Abbey and photographs of Philip Hyde in Slickrock (Abbey & Hyde 1971), which was a conscious attempt to influence public perceptions of the area. A very similar view was adopted by the Japanese photographer, Yoshikazu Shiradawa, whose Eternal America in 1975 is dominated by Canyonlands. Shirakawa's experience involved his "rediscovery of the earth"(Shirakawa 1975).

What are distinctive visual components of this desert experience (Smardon 1977)? Most of this essay has centered on the visual stereotypes which desert observers carry with them. And we have looked at the controlling power these stereotypes can have over us. It is equally important to look at the external forces which contribute to the visual experience. In 1935 the artist Maxfield Parrish wrote, "What is meant is...those qualities which delight us in nature--the sense of freedom, pure air and light, the magic of distance, and the saturated beauty of color" (Gussow n.d., McShine 1976).

Sky (aspect of VRVA space/scale). In 1835 Thomas Cole spoke of the sky as "the soul of all scenery...the fountain of light, and shade and color. Whatever expression the sky takes, the features of the landscape are affected in unison." In 1843 Emerson wrote, "The sky is the daily bread of the eyes." And in 1852 Thoreau described different skies in terms of different kinds of wine (McShine 1976). Eastern visitors find the desert sky almost an exaggeration. The eastern sky is perceived, if at all, through a jumble of branches and leaves, filtered by the perpetual haze of high moisture (and pollution) and often heavy with clouds. It forms an indistinct and distant background to close- and middle-distance objects. It may not be seen at all, a matter of indifference. In contrast, the illumination, weather conditions, clouds and figure-ground relationships of desert sky make it pre-eminent. It is seen unobstructed and becomes an experience both encircling and infinite. In 1962 Barnett Newman, a painter, wrote, "For me space is where I can feel all four horizons, not just the horizon in front of me and in back of me because then the experience of space exists only in volume" (McShine 1976). Sun, clouds, moon and stars seem more ideal than real. Landfords, trees and human beings seem to contract as the field of view expands. Not framed by windows, leaves, or branches, the objects of the desert are observed in the open and seem reduced in size and importance. Powell writes, "The heavens constitute a portion of the facade and mount into a vast dome from wall to wall....clouds creep out of canyons and wind into other canyons. The heavens seem to be alive, not moving as move the heavens over a plain, in one direction with the wind, but following the multiplied courses of these gorges....In the imagination the clouds belong to the sky, and when they are in the canyon the skies come down into the gorges and cling to the cliffs and lift them up to immeasureable heights...Thus they lend infinity to the walls" (Conron 1974).

Landforms. In 1976 Georgia O'Keefe said, "The black rocks from the road to the Glen Canyon dam seem to have become a symbol to me--of the wideness and wonder of the sky and the world. They have lain there for a long time with the sun and wind and the blowing sand making them into something that is precious to the eye and hand--to find with excitement, to treasure and love." (Figure 4*) Bold angular shapes of erosion form the scenery of Canyonlands for visitors. It is profoundly a world not made by man, a metaphysical stage set for superhuman events. In Colorado an old tourist site is called Garden of the Gods. The experience is like being present at a primeval moment before the creation. One stands under the encircling sky, in a bold, empty, simple, silent, and yet real terrain, at the center of a theophany (Eliade 1975). The shapes are aesthetically abstract and lend themselves to human interpretation. Canyonlands landfords have been, from the earliest days, interpreted as monumental architecture akin to the pyramids of Egypt, Stonehenge, or the figures of Easter Island. Powell took to temples, and named sites Isis, Buddha, Brahma, Zoroaster, Walhalla and Deva. For Americans, without a classical past, but hankering for one, the forms became America's ancient ruins out of a legendary past. In the 1830's, Thomas Cole had written, "We feel the want of associations such as cling to scenes in the old world. Simple nature is not quite sufficient. We want human interest, incident, and action, to render the effect of the landscape complete" (Zevi 1957, Shepard 1967). Much attention was given to the discovery of natural "ruins."

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*See color illustration on page 387.

Color. Powell's journal entry for June 7, 1869, concludes: "This evening, as I write, the sun is going down, and the shadows are settling in the canyon. The vermilion gleams and roseate hues, blending with the green and gray tints, are slowly changing to somber brown above and black shadows are creeping over them below; and now it is a dark portal to a region of gloom--the gateway through which we are to enter on our voyage of exploration tomorrow. What shall we find?" (Powell 1957) The most unanticipated feature of Canyonlands may be the extraordinary colors. New meaning is given to terms like color feeling, color weight, color intensity. After living with the shadings of greens, browns, blacks of a world filled with plants and soils, the strong reds, oranges, yellows, together with blue and azure in the sky, are new experiences. It is as if the age and varnish were removed, as when apparently gloomy Dutch masterpieces are brightly revived by the restorer's hand, and the original vivid colors the artist intended are recovered. It is an ontological discovery. We say, "So that's what the world is really like!" Eastern fecund scenery was appreciated at the same time of the appearance of the Claude Glass--low-toned pocket mirrors which not only were used to frame a scene, but to darken it to look like a dirty, heavily-varnished Rembrandt before the vivid colors were recovered (Shepard 1967). Color vision and color memory have also been greatly enhanced by the invention of color film in the 1930's. The impact of this new medium has not been adequately explored.

Soil-less/Lack of Vegetation. For most American travellers, important visual signals are missing in the psycholgically alien desert-a hazy horizon and sky forming a background to the close maze of branches and leaves along the Appalachian Trail in the Blue Ridge or Great Smokies, grassy loamy soil underfoot and soft air. It is difficult to use the old visual habits and old sense of perspective here; the desert is sensorily austere. Here is a region which flaunts its lack of vegetation. Georgia O'Keeffe uses bones and skulls as metaphors for the soilless, treeless land; both are down to irreducible basics. (Figure 5*) The masks and costumes are off. She once said, "Dirt resists you. It's very hard to make the earth your own" (O'Keeffe 1976, McShine 1976). In 1965 Andrew Wyeth wrote, "I prefer...when you feel the bone structure in the landscape--the lonliness of it....Something waits beneath it--the whole story doesn't show" (McShine 1976, Gussow n.d.). In Canyonlands prosaic ground cover is removed as nowhere else, and one is allowed to see the real *stuff* of eternal America. It is as if we suddenly know *too much*, as in a religious revelation. We do not expect clarification from a place so boundless and empty, devoid of comforting visual signals. Life is intensely acute when it is experienced without any mediation or gradual awareness. The desert, lacking a mediating cover, is a place of purgation, chastity and discipline.

Geology. The French historian, Fernand Braudel, when he looked for the long-range forces controlling human affairs, spoke of historical "structures" (Braudel 1966, 1972). These structures included climate and terrain as Braudel sought to emphasize the power of natural forces upon man. American history is said to be too brief to include Braudel's structures, but their presence appears in the desert, a virtual embodiment of the geological roots of American existence. Even the history of tourism, and its dependence upon the garden-park visual experience, involves the appropriation of geological knowledge. In the middle of the last century, fixed biblical time was replaced by primordial time. In the desert this geological world is unburdened by soil or ground cover, the structuralist world of unbelievably slow rhythms is open to view. The dimension of space is penetrated by the dimension of time. As Braudel argues, fleeting human events, even the spans of civilizations, are a temporary efflorescence compared to the tempo of the rocks. In Canyonlands, one has a sense of being "present at the creation," and at the end of time, and all ages in between. Powell combines biblical and geological imagery in his description of canyon rock formations: "Let us call this formation the variegated quartzite...Let this formation be called the cliff sandstone....Let it be called the red wall limestone..." (Conron 1974). Canyonlands becomes a metaphor for the eternal and the infinite. This is a rare experience in our abbreviated national history.

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*See color illustration on page 387.

In the above, attention to Canyonlands features has hardly been tapped. Space does not allow a further extension of this narrative.

Tourism, beginning with ancient and medieval origins, is a pilgrimage into the extraordinary, away from ordinary visual experiences (Shepard 1967). Historically, the common foundation for tourism in America was learning natural history and exploring strange places, with the hope of renewal or healing. The idea of the vacation as a general restorative from mundane and hectic daily existence drew increasing numbers to nature, which was understood to be therapeutic. Soon, as conveniences arose, travel in and of itself was supposed to be pleasureable. Tourism was an ideal way to use the new leisure time because of its educational and redeeming qualities.

Yet the naturalist-interpreter of a park or monument finds himself repeatedly responding to the boredom of the tourist, who begins to see his vacation as publicly expensive and privately monotonous. Today's tourist has trouble keeping busy, and seeks to keep his days filled with entertainments and recreation likely to be unconnected with the visual potential around him. His awareness is clogged by anticipation and anxiety, and he is disappointed. The visitor's disappointment may be the result of limited, scanty, or inappropriate anticipation. I suspect the vacationer seeks one particular phenomenon as part of a holiday fantasy--to experience a kind of rapture, arousal of primeval feelings and transports of the imagination. The desert is a region off the map for most tourists, with their visual baggage tied to the garden park. This absence of recognizeable landmarks means encounter with a truly alien wilderness. This getting lost involves an acute visual disorientation leading to the experience of being out-of-control. The potential rapture or transports which result is a major these of Edward Abbey's narratives about the desert (Abbey 1960, 1977).

We habitually bind ourselves to routine visual patterns. We are in danger of seeing only a world of labels which stereotype our visual worlds. We repeatedly invent the same landscapes (Lowenthal & Bowden 1976, Watts 1975). We have also looked at the visual innocence of the American traveller in the sense that he does not recognize his visual traditions. We have also looked at his lack of conscious visual techniques to the extent that his visual responses to new scenery are largely naive and unconscious. One must admit the virtues of spontaneity and yet management of the visual landscape implies teaching the visitor not only content but technique.

We are enquiring into the question of human access to the physical facts of a landscape. Simultaneously, the landscape is the concrete embodiment of a person's (nation's) habits, needs, values and ideals. Georgia O'Keeffe said that the world of shapes and colors makes more definite and enduring statements than does the world of words (O'Keeffe 1976). The landscape historian John Conron argues that when a traveller encounters an extraordinary place, "we are awed, not informed ....we settle for celebrating the sheer amazing fact that this wondrous thing is self-sufficiently there before us"(Conron 1974). Space, more than time, roots the American experience; space is the central fact of American history.

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Conducting a Wildland Visual Resources Inventory[1]

James F. Palmer[2]

Abstract: This paper describes a procedure for systematically inventorying the visual resources of wildland environments. Visual attributes are recorded photographically using two separate sampling methods: one based on professional judgment and the other on random selection. The location and description of each inventoried scene are recorded on U.S. Geological Survey topographic maps and in field notes.

This procedure was applied to nearly 100 miles of the Appalachian Trail at an estimate cost of $24 per mile, placing it well within a budgetary range of most wildland units.

The conclusion discusses some of the potential management uses for a visual resource inventory as a tool in understanding the user-public's perceptions of the resource base.

INTRODUCTION

Most managers responsible for wildland areas feel they need to know more about the attitudes and behaviors of the user-public for their decisions to be both more effective and valid. The management principles proposed by the National Park Service's Appalachian Trail Project Office (ATPO) typify this outlook. They recognize that the "Appalachian Trail experience is heavily influenced by what the hiker *perceives* in the surrounding environment." {Emphasis added.} The management principles also declare that "resource protection and quality of the user experience should receive primary concern in the design and management of the Trail and related facilities." In addition, "management decisions should be based on information of the Trail's natural and cultural resources" (U.S.Department of Interior 1978).

The Appalachian Trail presents a unique opportunity to study user perceptions because it is a fundamentally different type of resource from most designated wilderness areas. Although the Trail is more than two thousand miles in length, it is normally considered to be only a few hundred feet wide. "The Appalachian Trail is a way, continuous from Katahdin in Maine to Springer Mountain in Georgia, for travel on foot through the wild, scenic, woods, pastoral, and culturally significant lands of the Appalachian Mountains" (U.S. Department of Interior 1978). Even though it is thought of as a wilderness trail, it obviously leads hikers through a diversity of environments. Each of these environments contributes to the Trail's character; each provides a different setting for experience; each may elicit different hiking-related activities. Managing a recreation resource to provide users with both unity and diversity among the types of environments they experience is a challenging dilemma, one which the ATPO is confronting.

Studies of Appalachian Trail user attitudes and perceptions are relatively few in contrast to studies of Western wilderness users. Clark's (1977) extensive bibliography of Appalachian Trail related research identifies only two published studies of AT users (Bolduc 1973; Murray 1974). Bolduc criticizes his own procedures for investigating the appeal of hiking as too open ended and suggests that "had a more sensitive methodology been utilized, the schema may have been more useful" (Bolduc 1972). On the other hand, Murray's study utilized a questionnaire that focused on user attitudes toward specific management practices. However, neither of these studies sought to to inventory first trail qualities which affect the user's experience. This paper reports a procedure for inventorying visable trail qualities which was developed for the ATPO and applied along the Appalachian Trail through Massachusetts.

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[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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PROCEDURE

Since there was no comprehensive a priori knowledge of the qualities important to hikers on the Appalachian Trail, a photographically recorded inventory was collected. Obviously, the total range of wildland qualities as well as much of a hiker's potential experience cannot be represented in a photographic record. However, it seems to be an efficacious procedure since an estimated "87 percent of man's perception is based on sight" (U.S. Department of Agriculture 1973).

Equipment

All photographs were taken using a high quality camera. A single lens reflex system was used to provide accuracy and ease in light metering and reliability in previewing elements within the camera's range. The wide-angle (35mm) lens employed has a coverage of 62 degrees which provides a good approximation of a hiker's field of view. Kodacolor film was used because it was sensitive to the warm tones which are frequently overwhelmed in an environment dominated by blues and greens. A sufficiently fast lens (F2.0) and film (ASA 100) were chosen for use under the low light conditions of wooded environments. When taking photographs, exposures were selected to create a maximum depth of field.

The time and location of each photograph were logged in a field notebook and on a U.S. Geological Survey topographic map. These field notes were also used to document features and characteristics significant in the author's hiking experience and to record conversations with people encountered along the Trail.

Sampling

Two distinct strategies were used to compile the inventory. The first strategy produced a random sample of possible views. Photographs were taken systematically at half-hour intervals during actual hiking time. At each stopping point, two eye-level photographs were taken at random angles. These photograph were nonoverlapping in order to maximize the information in the inventory. This procedure provides a representative sample of the Trail' overall condition as experienced by a hiker.

The second strategy was essentially subjective. Photographs were taken of distinctive environments that the author thought represented importants aspects of the Trail. This subjective record generally captured the occasional, "rare" conditions that otherwise were not well represented in the random inventory. Particular attention was paid to representing conditions referred to in conversations with other hikers as well as those which were significant in the author's experience.

APPLICATION

The inventory was conducted by the author during July and August of 1977. The trail was experienced under a variety of conditions. Field work was done on days of 100°F heat as well as chilly, rainy weather. In addition, the length of hikes taken included weeklong and daylong journeys and were walked both alone and with companions. However, a conscious effort was made to maintain a relatively consistent photographic quality among the inventoried hiking environments. All photographs were taken to represent normal daylight conditions. The subjectively sampled scenes were photographed just as they were experienced by the author while hiking; the randomly sampled scenes were photographed without compositional adjustments. In all, 184 randomly selected and 186 subjectively selected Trail environments were inventoried. This amounts to approximately four inventoried scenes per mile.

Illustrative Example

An illustrative example is perhaps the clearest way to describe the contents of the trail inventory. Figure 1 shows the 22 scenes inventoried in and around Cheshire, Massachusetts. Each of these scenes is located on the accompanying USGS topographic map (fig. 2). The following description of this area is constructed from the author's field notes.

The first several scenes (photos 1 through 5) were all encountered along an area being

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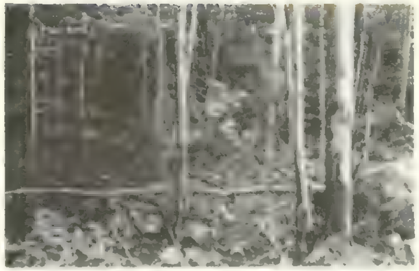
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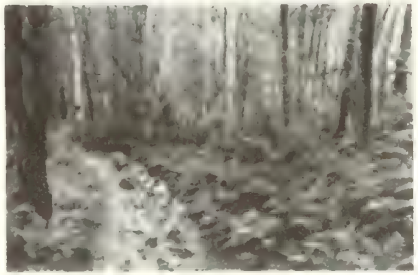
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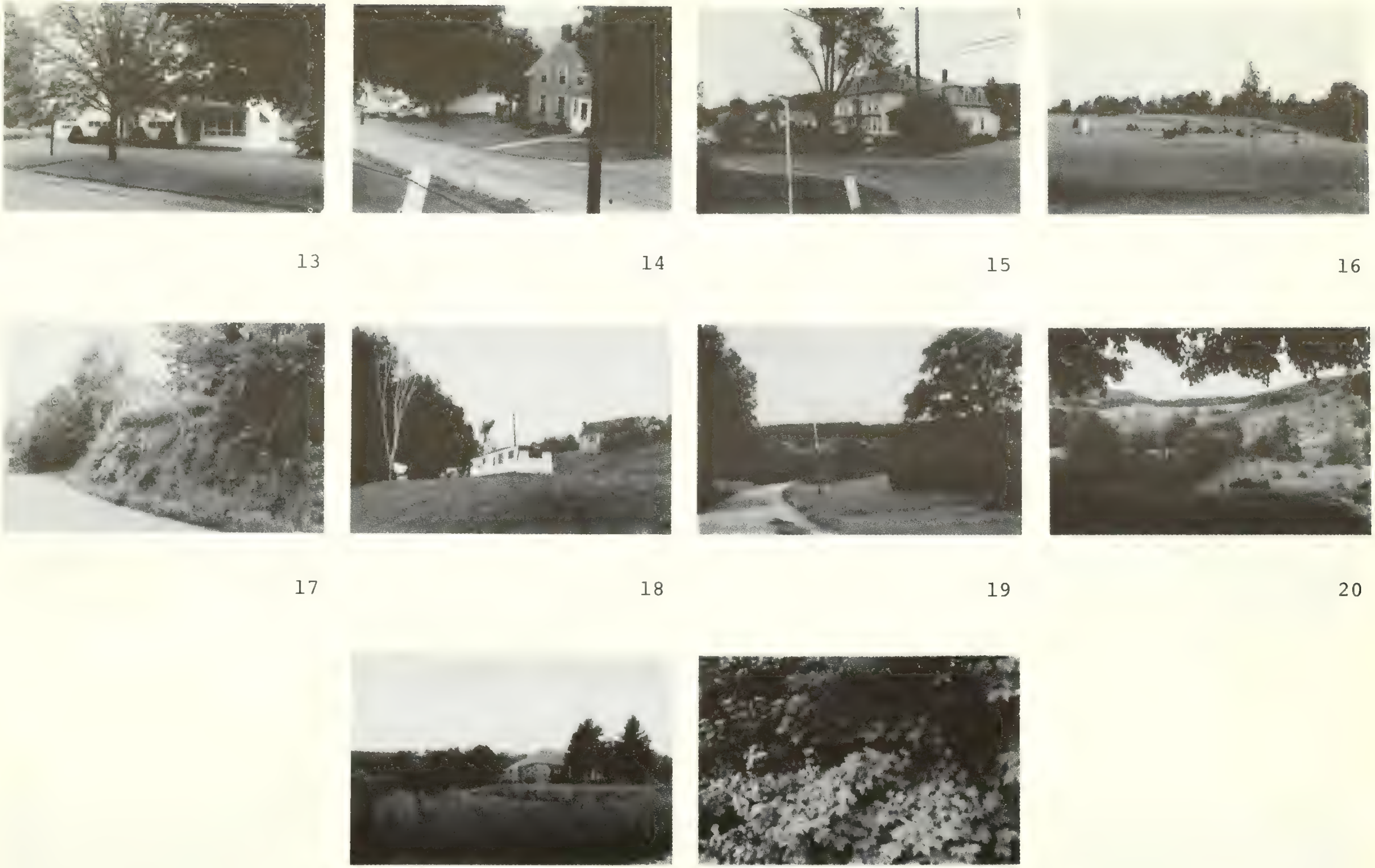

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Figure 1--Photographs of environments on the Appalachian Trail in and around Cheshire, Massachusetts.

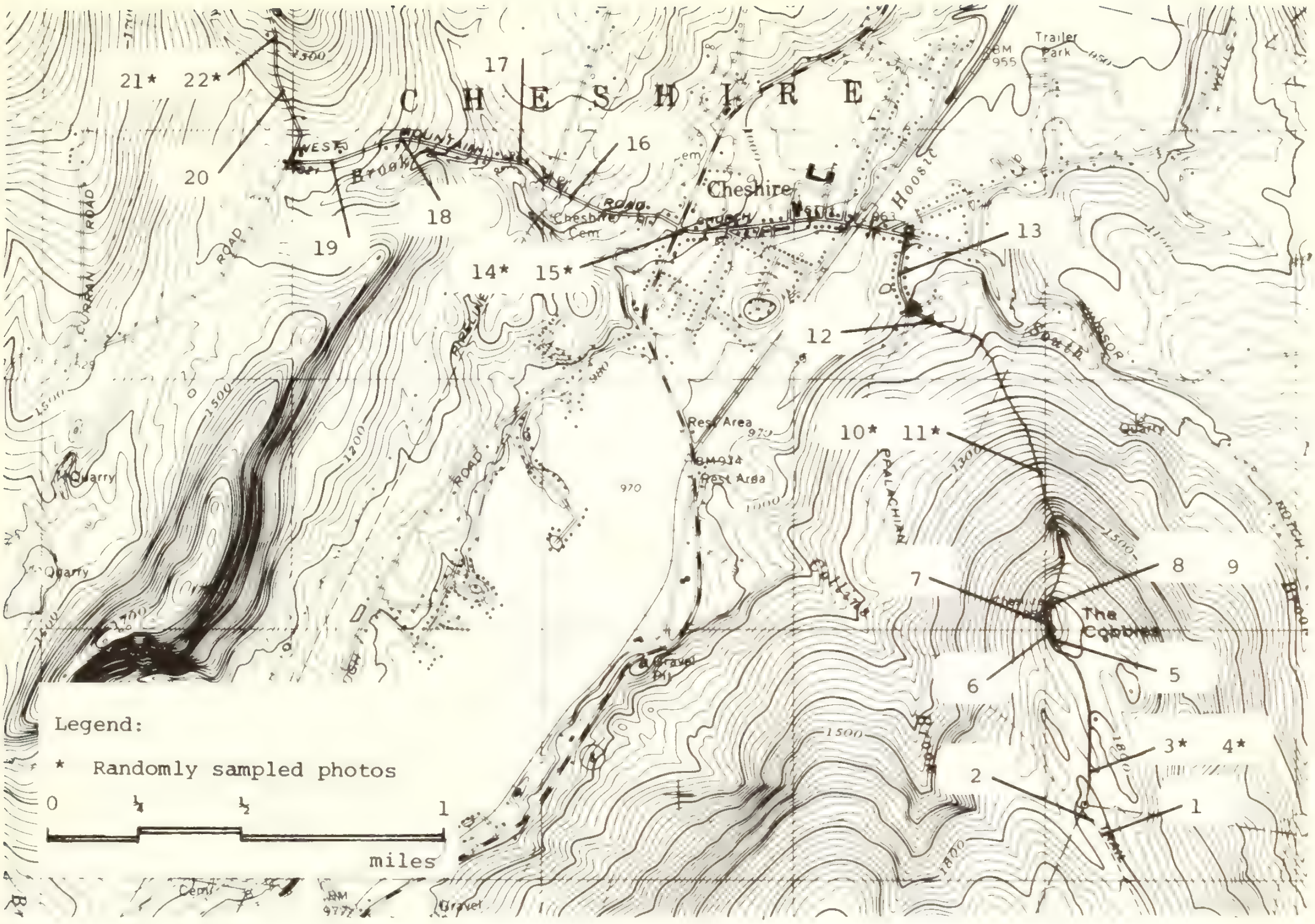

Figure 2 -- Sample field locating 22 inventoried scenes on the Appalachian Trail in and around Cheshire, Massachusetts.

actively logged. The uprooted trees in photos 1 and 2 were an obvious indication of disruption along the Trail. However, more subtle indications may also intrude into a hiker's experience, for instance the slash piles in photos 3 through 5. Distant views from The Cobbles and other highlands were normally obscured by enclosing vegetation (photo 7). However, there were two (and only two) specific spots from which hikers could view the Cheshire Reservoir (photos 6 and 9) and the town of Cheshire (photo 8). Photos 9 through 11 were typical of the northern hardwood forest which predominates other cover types and land uses throughout the study area. Areas with severe erosion due to inadequate drainage (photo 11) and poor trail design (photo 12) were easily identified from the inventory. It was possible that both these conditions were aggravated by increased usage due to the proximity to developed land uses. The town of Cheshire was represented by a small bungalow (photo 13), large house (photo 14), and rest home (photo 15). These were typical scenes from the half mile of Trail passing through Cheshire center. In contrast to the wooded areas immediately south of Cheshire, the northern edge of town has a very rural character. The rural residences in photos 18, 19 and 21 were relatively isolated structures and in less manicured settings than the more urban scenes in photos 13 through 15. Rural qualities were also represented by colorful natural roadside verges and the absence of highway shoulders in photos 17 and 19. Open spaces such as a grave yard (photo 16) and abandoned field (photo 20) were also reminicent of rural qualities. Approximately 1½ miles north of Cheshire center, the Trail was again enclosed by the northern hardwood forest (photo 22).

This particular section of the Trail was chosen because of its unusually diverse qualities which represent the potential range available in this geographic region. The inventoried environments for several miles both north and south of this area have a much more homogenous quality, being almost entirely represented by enclosed wooded scenes (id. photos 7, 10 and 22) with occasional interludes of muddy and difficult pathways (id. photo 11). It is clearly the intention of the National Trails System Act (1968) that the Appalachian Trail represent the "scenic, historic, natural, or cultural qualities of the areas through which such trails may pass." This illustrative example has shown that the inventory process can be used effectively to describe these qualities. In addition, it provides a permanent record that may be used as base data for further trail evaluations and assessments.

Estimated Costs

In all, the author inventoried approximately 100 miles of the Appalachian Trail using these procedures. The following tabulation provides a breakdown of the estimated direct expenses encountered while conducting the inventory.

Salary	
Fieldwork (14 days at $40 per day)	$ 560
Office work (28 days at $40 per day)	1120
	1680
Supplies and Equipment	
Food (14 days at $7.50 per day)	105
Backpacking rental (includes tent, stove, sleeping bag, pack and frame at $100 per week)	200
Supplies (maps, compass, notebooks and miscellaneous office supplies)	60
Photographic supplies (camera rental, 12 roles of film, processing and 450 3½-by-5 inch color proofs)	250
Transportation (700 miles at 17¢ per mile)	150
	$ 720
Total Costs	$2400

These figures reflect the author's actual experience and include such unexpected expenses as being caught in the field during rainy weather. However, they do not include typical overhead expenses such as personnel supervision. Perhaps more important, the quoted salary values do not include any additional compensation for living in the field nor for periods of forced inactivity, such as waiting for photographic processing.

How much would it cost if a wildland manager wanted to conduct a comprehensive visual resource inventory? The Appalachian Trail would come in at less than $50,000 based on the above rate of $24 per mile. When compared to comprehensive inventories of other major natural resources, this is a real bargain.

UTILITY

In and of itself, a visual resources inventory is only a descriptive record; a tool to be used by wildland managers like they would use a species list. While the purpose of this paper is to outline the procedures used to conduct a visual resource inventory, it may be helpful to discuss briefly its potential utility for further trail evaluation and assessment.

The primary purpose of creating a photographically recorded inventory is to document the visual resource's conditions for reasons relating to wildland management. This type of documentation is especially important if managers are going to come to grips with the visual effects of change over time and space. For instance, managers or hikers are able to make comparative judgements concerning sections of the Trail separated by hundreds of miles when evaluating the conditions documented in the inventory. Similarly, if suitable inventories exist evaluations could also be made between alternate routes or past and present conditions.

The Appalachian Trail visual resource inventory was used by the author to simulate trai conditions during a psychometric scaling procedure. The results established a generalized classification used by hikers when describing or thinking about trail environments.[3]

1. *Rural towns* are areas dominated by things built by people, such as paved roads, residential neighborhoods, shopping centers, and industrial areas.

2. *Countryside* environments are also heavily influenced by people, but this influence is potentially less permanent. Examples include pastures, abandoned

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[3] Palmer, James F. In press. The conceptual typing of trail environments: a tool for recreation research management. In Assessment of amenity resource values. T. Daniel and E. H. Zube, eds. Rocky Mountain Forest and Range Exp. Stn., Fort Collins, Colorado

country roads, agricultural fields, rustic structures, and powerline rights-of-way.

3. *Vistas* are prominent views over the landscape.

4. *Backwoods* environments are wooded and without any particularly distinguishing feature, noticeable evidence of people, or an obvious presence of the trail.

5. *Trailside features* are special objects of interest that occur within the backwoods and pathways environments. Examples include streams, a stand of birch trees, interesting rocks, and directional signs.

6. *Pathway* environments are dominated by the obvious presence of the trail or hikers on the trail, but are otherwise very similar to backwoods environments.

7. *Logging activity* occurs where trees have blown over the trail, where there is slash lying on the trail, or where timbering is taking place.

Analysis suggests the primary criterion of this classification is a perceptual sensitivity to cultural changes in the natural environment.

A significant benefit of the random sampling procedure is that it provides managers with sufficient data to assess the extent of the visual resource. Considering all 100 miles within the inventoried study area, rural towns and countrysides compose approximately 10 percent of the environments experienced by hikers. Though highly valued by hikers, vistas are found along less than 5 percent of the Trail. An overwhelming 80 percent of a hiker's experience is among backwoods with an additional 5 percent being divided among pathways and trailside features. There are no examples of logging activity in the random sample and it is estimated from the author's field notes that their occurence was less than 1 percent. Such unbiased estimations are an unusual feature for a visual assessment and are unquestionably a strength of the procedures used in this study.

A complete analysis of research results utilizing this visual resource inventory (Palmer 1979) led to the following management and planning recommendations for the study area.

1. Vistas provide a unique opportunity to increase the diversity of environments perceived by hikers as well as providing a more desirable hiking experience. Management action should be considered to maintain and increase the quantity and quality of trailside vistas.

2. The central portion of the study area is notably lacking in the experiential variety that characterized the illustrative example of Cheshire. Management action should be taken to increase the diversity of perceived environments, recognizing that backwoods environments will still be the mainstay of that experience.

3. Even though the countryside environments are an important part of the Berkshire's perceived character, they are poorly represented along the Trail. Management action should be taken to increase the quantity and quality of countryside environments visable from the Trail.

Each of these recommendations is aimed at furthering the intentions of the National Trail System Act (1968) and the ATPO's management principles (U.S. Department of Interior 1978) along the Appalachian Trail within Massachusetts.

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Visual Unit Analysis: A Descriptive Approach to Landscape Assessment[1]

R.J. Tetlow, and S.R.J. Sheppard[2]

Abstract: Analysis of the visible attributes of landscapes is an important component of the planning process. When landscapes are at regional scale, economical and effective methodologies are critical. The Visual Unit concept appears to offer a logical and useful framework for description and evaluation. The concept subdivides landscape into coherent, spatially-defined units.

This study extends that concept by developing methods for consistent mapping and analysis based on available topographic data and aerial photographs, supplemented by field checks. This approach to describing scenic distinction, supplemented by graphic displays, permits comparison of visual attributes for the landscape units in a study area, supporting planning and design.

VISUAL ANALYSIS AND THE VISUAL UNIT

The aim of visual analysis is to ensure recognition and consideration of the visual qualities of the landscape in the process of environmental design and management.

Various methods of visual analysis have arisen in response to need. Some are based upon criteria related to the landscape in only a general or indirect way, including assessment of visibility from static viewpoints. Others modify results according to viewing distances from available roads or trails.

Methods are needed which provide more flexible applications and a more comprehensive range of information, related to specific landscape tracts and their inherent landscape qualities. The visual unit concept (Litton, Shizowa, 1971; Tetlow,1975)[3] appears to offer a logical and useful framework for evaluation of the landscape, proposing its division into units which are coherent for planning or analysis purposes. This paper extends the concept and defines a practical and economical procedure for routine use.

The Visual Unit is defined as a portion of the landscape enclosed and limited by topography, bounding an observer's field of view. That spatial enclosure enables the viewer to accumulate and form a unified impression of his surroundings (Tetlow and Sheppard 1976). Because each landscape is inherently variable in appearance, as well as in spatial extent, each unit has its own distinct visual character and degree of unity; its specific scenic distinction is created by the combination of landscape elements within it and bounding it.

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[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Professor, University of California, Berkeley: Research specialist, Univ. of Calif in cooperation with Pacific Southwest Forest and Range Experiment Station, Berkeley, Ca.

[3] Tetlow, R.J., 1975. Scenic Units and their Interrelationship in the Forest Landscape. USDA, Forest Service, Pac SW Forest and Range Exp. Sta. (Manuscript).

VISUAL UNIT MAPPING

For purposes of mapping, the concept of the visual unit as a bounded space requires that topography be the dominant criterion for delineating unit boundaries. These normally follow major ridge lines and enclosing spurs, or marked changes in topographic character (fig. 1).

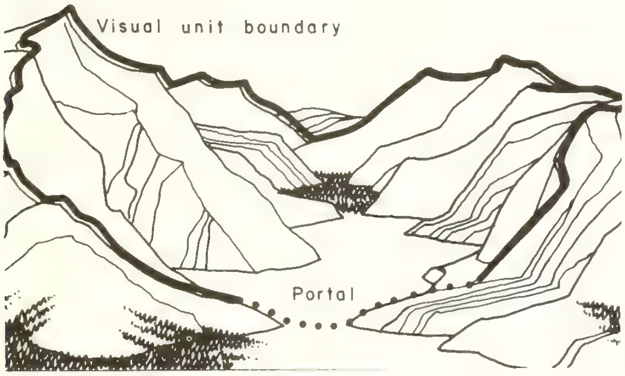


Figure 1 -- A Typical Visual Unit

Visual units are seldom completely enclosed. It is common to find at least one or more openings or portals where the skyline dips to provide a threshold for drainage, access or views outward (fig. 1). Portals are important for observer orientation and for potential movement into or through the unit. The stereopair and drawing in figure 2 illustrates how unit boundaries and portals may be located relative to topography.

Where a unit boundary coincides with a major ridgeline, this division is readily apparent and easily mapped. More commonly, unit boundaries follow complex high ground. In such cases, the unit appears less strikingly enclosed from most points on the ground. It is often possible to map a "false" enclosure or rim intervening between a valley floor and the unit boundary. Rims mark the extent of views from valley floors, upper slopes being foreshortened or invisible. In such cases there is no definite and perceptible ridge-line, as in the example of a narrow flat-topped ridge separating adjacent valley units. Here, the boundary may be assumed to run down the center of the ridgetop above the rim. An example is shown in figure 3.

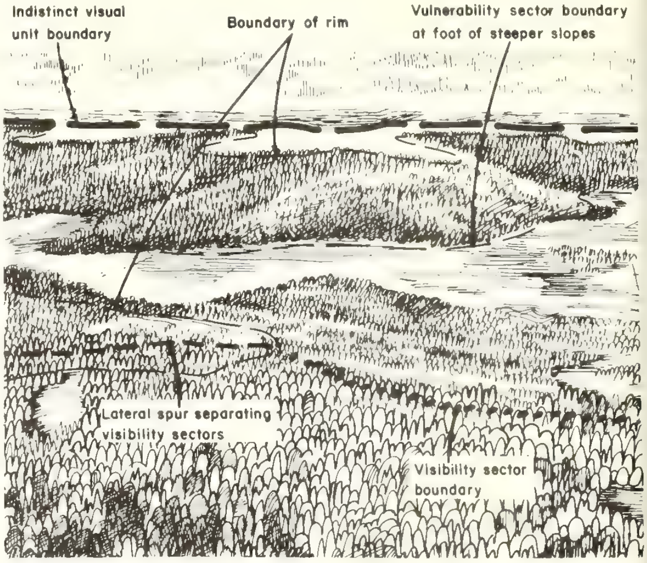

Indistinct visual unit boundary
Boundary of rim
Vulnerability sector boundary at foot of steeper slopes
Lateral spur separating visibility sectors
Visibility sector boundary

Figure 3 -- Fellers Heights: Oblique view showing rims, visibility sectors, and vulnerability sectors.

The mapped geographical arrangement of visual units and their portals indicates the sequence of differing landscapes to be seen along possible travel routes. Mapped visual units also convey much information on visibility. A unit boundary usually marks a distinct change in the extent and direction of views from the ground. However, a map of visual unit boundaries is not a visibility map per se, since no specific observer locations form the basis for boundary definition. Specific views and visibility will alter with change of observer position; within the unit boundary---wherever the observer is---a spatially defined impression of landscape character is likely to be obtained. Within or beyond a visual unit, individual features or scenic elements which contribute to scenic distinction may be identified.

Visual units may be subdivided to provide more specific information. Some extensive or complex visual units can be subdivided into visibility sectors. These are defined by minor differences in landscape character or by minor impediments to lines of sight (fig. 3).

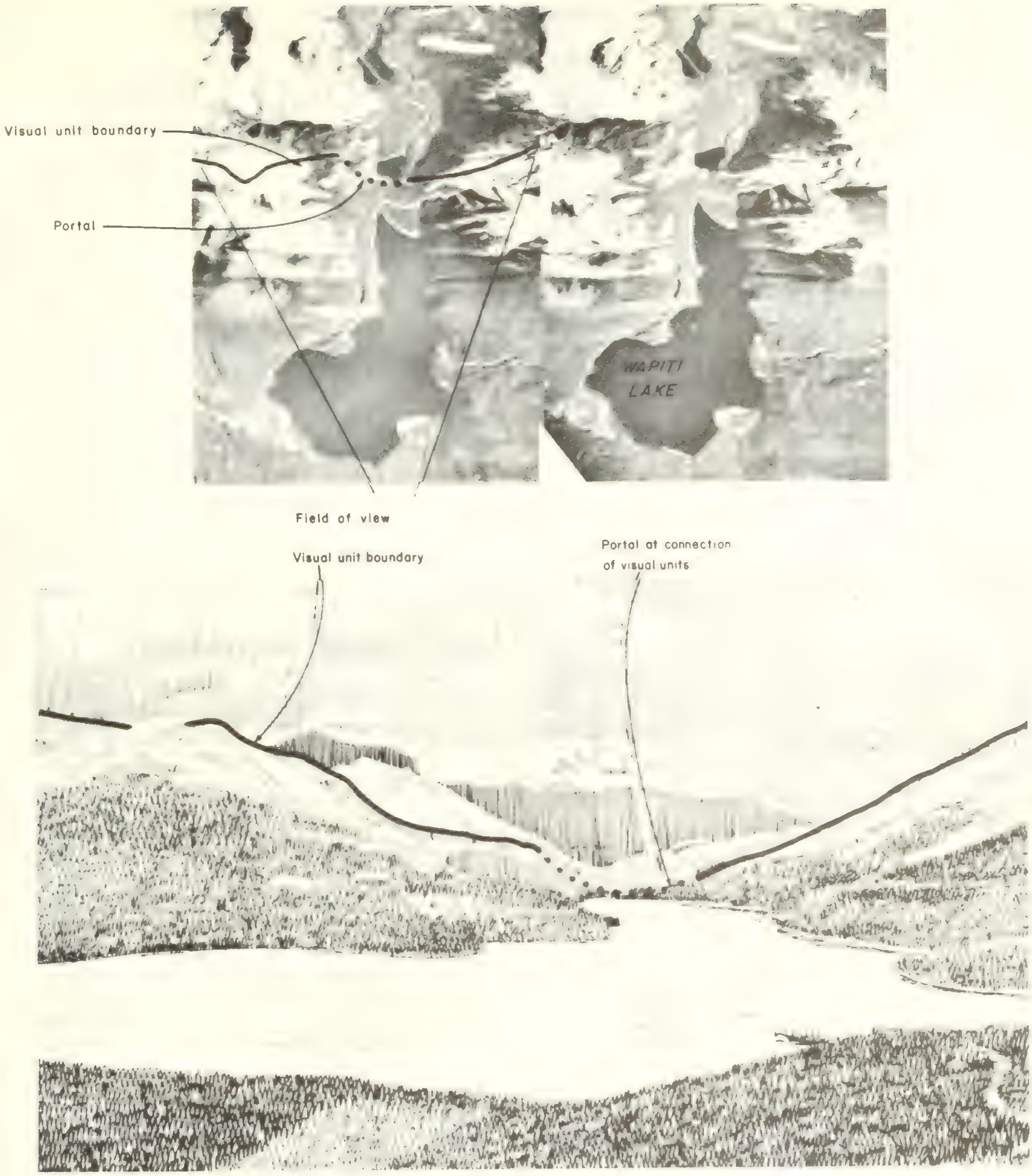


Figure 2 -- Wapiti Lake: Stereo-pair and oblique view showing visual unit boundaries.

If the visual unit is to remain a distinct entity, there must be limits to its complexity. For mapping purposes, it is important to discriminate between a valley as a visibility sector in a larger unit, and a valley as a separate unit. A major symmetrical fork in a valley is usually best mapped as the convergence of three units, linked by portals. Large side-valleys, visually cut off from a unit by elevation difference or by narrow "pinching" of spurs, may form separate units, while side-valleys largely visible from, and contiguous with the main valley, form visibility sectors.

SCENIC DISTINCTION RANKING

The term scenic distinction refers primarily to the connotation "distinct", but implies higher scenic quality when visual characteristics are vivid or striking.

The system adopted for scenic distinction ranking is based on the thesis that more vivid or more distinguishable landscapes (Litton, 1968) are those of inherently greater scenic potential. Each mapped visual unit is given a scenic distinction ranking score, indicative of its distinctive values. The system is based upon twenty scenic distinction factors, which broadly describe and indicate the scenic distinction of a visual unit for comparison with other regional units. Each factor carries a ranking score of 0, 1, 2, 4, or 10, on a scale of low to high scenic quality. The maximum score of 10 reflects the disproportionately high impact which outstanding features have on the creation of distinct landscape images. Each visual unit is assigned a score for every factor, and the twenty scores are totalled to give the unit an overall scenic distinction ranking between 0 and 200, expressive of its general visual quality.

The scenic distinction factors describe the spatial dimensions and visual character of the unit, its water forms, its distinctive features and accents, its linkage with other units, and any degrading contrasts. These scenic distinction factors are assigned without reference to either existing access conditions or specific physical use potentials. Many are generally accepted in the literature as contributing to scenic quality, and have precedents in the work of Leopold (1969), Linton (1968), Shafer, Hamilton, and Schmidt, (1970), and the U.S. Forest Service (1973). The authors, however, have selected and defined the factors presented here.

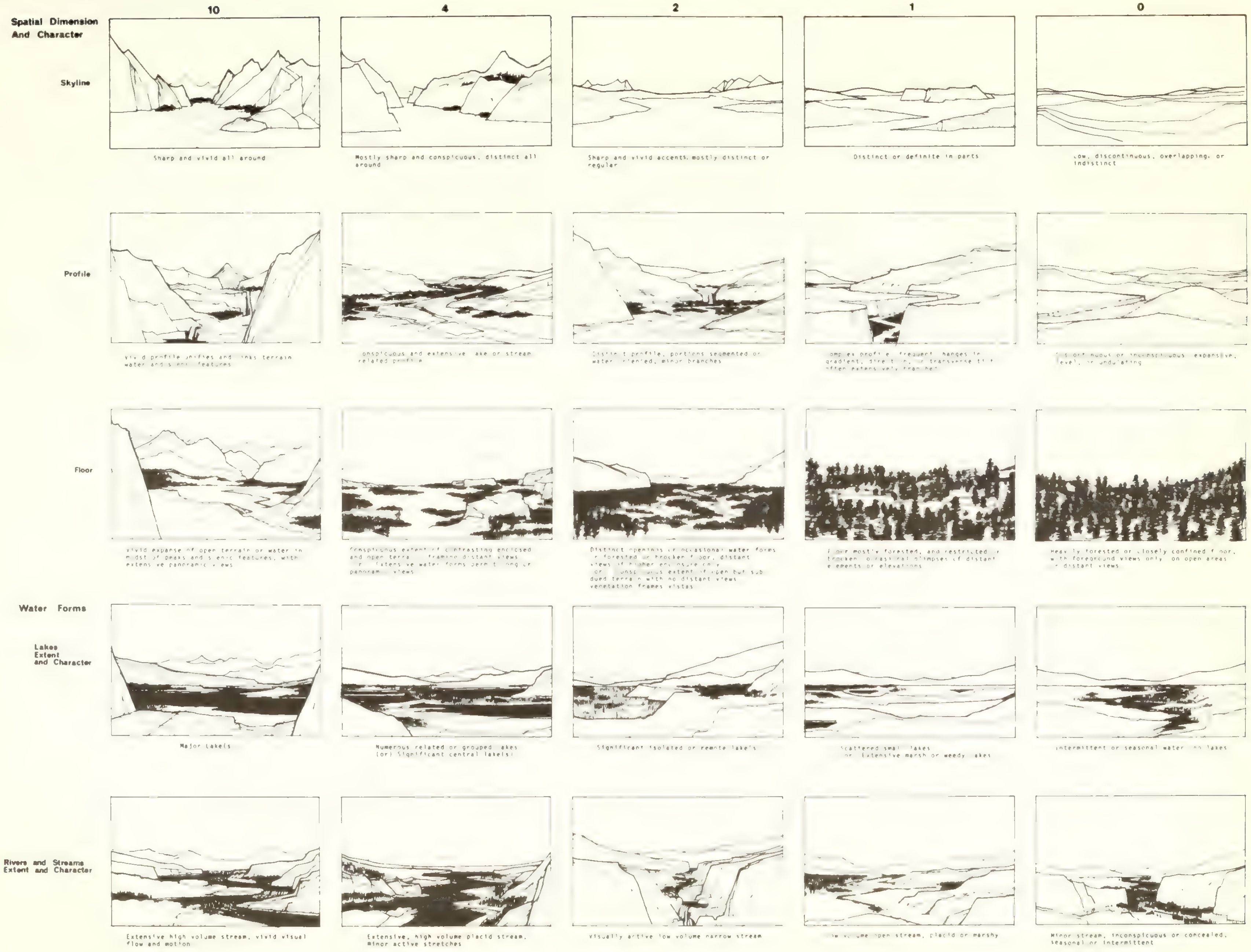
In this system, the number of factors is limited to twenty in order to keep the work within reasonable limits. For simplicity, the ranking system attaches equal weight to all factors, since it is considered that a change in any one of them is sufficiently important to alter the scenic character of the unit noticeably. However, the system does, by the choice of factors used, emphasize dominant elements such as water and the parameters of three-dimensional landscape space.

Vegetation often has a lesser influence in determining scenic distinction in regions, with a variety of topography. In units of subdued topography, without hills or mountains, variety in plant cover, type, form, and color may make the dominant contribution to scenic value, or may markedly affect scenic quality on a local or seasonal basis. Examples of scenic distinction factors are graphically illustrated and described in figure 4.

Since the system attempts to evaluate defined scenic landscapes in terms of the whole regional landscape fabric, rather than cataloguing scenic views and elements in isolation, certain of the scenic distinction factors stress the overlapping influences of adjacent units. The visual unit is the major subdivision to be evaluated in detail, but each unit depends strongly upon its position and relationship with other units.

The scoring system places reliance on simplicity and equal intervals between subdivisions. Where a factor varies in visual quality in various places within a single unit, the score assigned is that of the highest quality occurring in a significant portion of the unit. The resulting total scores express the relative vividness or obscurity of the landscape image, in the context defined above.

Visual units of relatively low scenic distinction tend to be broad depressions or plateaus with indistinct enclosure, having little visual variety in elevation, water forms, or striking features. Visual units of moderate scenic distinction may have definite topographic enclosure and clear orientation, but contain few visual features and characteristics of high contrast. Visual units of high scenic distinction are generally strongly oriented, containing bold contrasts in relief, skylines, water features, and vegetation. Units of very high or outstanding scenic distinction tend to exhibit a considerable number of vivid scenic elements, combined in a unified and



10
4
2
1
0
Spatial Dimension And Character
Skyline
Sharp and vivid all around
Mostly sharp and conspicuous, distinct all around
Sharp and vivid accents, mostly distinct or regular
Distinct or definite in parts
Low, discontinuous, overlapping, or indistinct
Profile
Vivid profile unifies and links terrain water and scenic features
Conspicuous and extensive lake or stream related profile
Distinct profile, portions segmented or water oriented, minor branches
Complex profile, frequent changes in gradient, direction, or transverse tilt often extensively branched
Continuous or inconspicuous, expansive, level, or undulating
Floor
Vivid expanse of open terrain or water in midst of peaks and scenic features, with extensive panoramic views
Conspicuous extent of contrasting enclosed and open terrain framing distant views (or) extensive water forms permitting long or panoramic views
Distinct openings or occasional water forms in forested or brocken floor, distant views of higher enclosure only (or) conspicuous extent of open but subdued terrain with no distant views vegetation frames vistas
Floor mostly forested, and restricted or brocken, occasional glimpses of distant elements or elevations
Heavily forested or closely confined floor, with foreground views only, on open areas or distant views
Water Forms
Lakes Extent and Character
Major Lake(s)
Numerous related or grouped lakes (or) Significant central lake(s)
Significant isolated or remote lake's
Scattered small lakes (or) Extensive marsh or weedy lakes
Intermittent or seasonal water, no lakes
Rivers and Streams Extent and Character
Extensive high volume stream, vivid visual flow and motion
Extensive, high volume placid stream, minor active stretches
Visually active low volume narrow stream
Low volume open stream, placid or marshy
Minor stream, inconspicuous or concealed, seasonal or intermittent

Figure 4 -- Examples of the twenty scenic distinction factors.

MAP REFERENCE 93 I/NW UNIT NAME	SPATIAL DIMENSION & CHARACTER								WATER FORMS					DISTINCTIVE FEATURES & ACCENTS							RANKING SCORE
									EXTENT AND CHARACTER		SHORELINE FORM										
	SPATIAL VIVIDNESS	CROSS-SECTION COMPLEXITY	CROSS-SECTION PROPORTION INDEX	CROSS SECTION CONTRAST	LINEARITY CONTINUITY	SKYLINE	PROFILE	FLOOR	LAKES	RIVERS STREAMS	LAKES	RIVERS STREAMS	WATER SETTING	SETTING FREQUENCY	FALLS AND RAPIDS	PEAKS, TOPOGRAPHIC ELEMENTS GEOMORPHIC FEATURES	SNOW AND ICE	VEGETATION CONTRASTS	VISUAL UNIT LINKAGES	IMPACTS & DEGRADING CONTRASTS	
MURRAY RIVER	4	10	10	4	4	2	10	4	2	10	2	10	4	10	10	4	2	4	4	2	112
HOMINKA PASS	10	10	10	10	1	4	1	10	2	1	2	1	10	4	1	10	4	4	4	10	109
UPPER HOMINKA	10	10	10	10	1	10	10	10	2	1	2	2	4	4	1	10	2	10	2	10	121
HOMINKA RIVER	10	10	10	10	4	2	10	4	4	4	4	4	4	4	2	10	2	10	4	10	122
MISSINKA RIVER	10	10	10	10	4	2	2	4	1	2	0	4	2	2	0	4	2	4	4	10	87

Table 1 -- Scenic distinction factors and visual unit ranking examples.

unusually distinctive whole. Table 1 shows an array of such scores, as recorded for various visual units within the Canadian Rockies.

VISUAL VULNERABILITY ASSESSMENT

Visual Vulnerability is the potential of a landscape to absorb or be visually disturbed by man's activities (Litton, 1974). In many units, vulnerability sectors may be distinguished, differing in slope or surface pattern (fig. 3).

Visual vulnerability is assessed for each vulnerability sector on the basis of slope and surface patterns. Generally, sectors of low vulnerability have gentler slopes and conspicuous irregular or horizontal patterns of bare ground and vegetation; this may allow landscape alterations to be absorbed almost unnoticed. Sectors of high visual vulnerability occur with steep slopes or with uniform or vertically-oriented surface pattern, where many impacts, notably those of transportation routes, would radically alter the appearance of the landscape. Figure 5 indicates how the various surface patterns may be categorized, and combines them with slope classes into a matrix for assessing visual vulnerability.This example deals primarily with vulnerability to any linear impact, oriented generally along the contour. However, the assessment also indicates vulnerability to point impacts and area impacts (Litton, Tetlow, Sorenson, and Beatty 1974),

INVENTORY TECHNIQUES

The methodology was first applied in an inaccessible tract of the Rocky Mountains and foothills in British Columbia, Canada, during 1976. The study area encompassed over 10,000 square miles of virtually undeveloped landscape, containing scenery ranging from rolling prairie to rugged mountains. Ground access was severely limited. Proposed development alternatives for coal mining, road and rail transportation, and townsites penetrated much of the area. The visual unit method was used to evaluate the entire study area, and to assess proposed developments within particular landscapes.

Where study areas are large, most of the base data must be derived from aerial photographic interpretation. An Old Delft scanning stereoscope may be used to determine unit boundaries, scanning 1":80-chain vertical photographs, with parallel reference made to 1:100,000 topographic maps, on which boundaries may be recorded. 1":40-chain and 1":20-chain photographs are used for the detailed sector mapping and for analysis of any proposed developments.

Extensive photographic coverage on 35mm film, using both color and black and white film, serves to corroborate preliminary findings on unit boundaries and features and to provide information on both scenic distinction and visual vulnerability. A combination of fixed-wing and low level helicopter flights, with limited ground access, provides a considerable amount of data simply and quickly. Final evaluation costs depend largely upon the extent of field-checking required from aircraft or vehicles. The methodology has subsequently been used in several studies undertaken by the Resource Analysis Branch of the British Columbia Ministry of Environment[4]

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[4] Adams River, Bowen Island, NECoal 1977, (In-house studies).

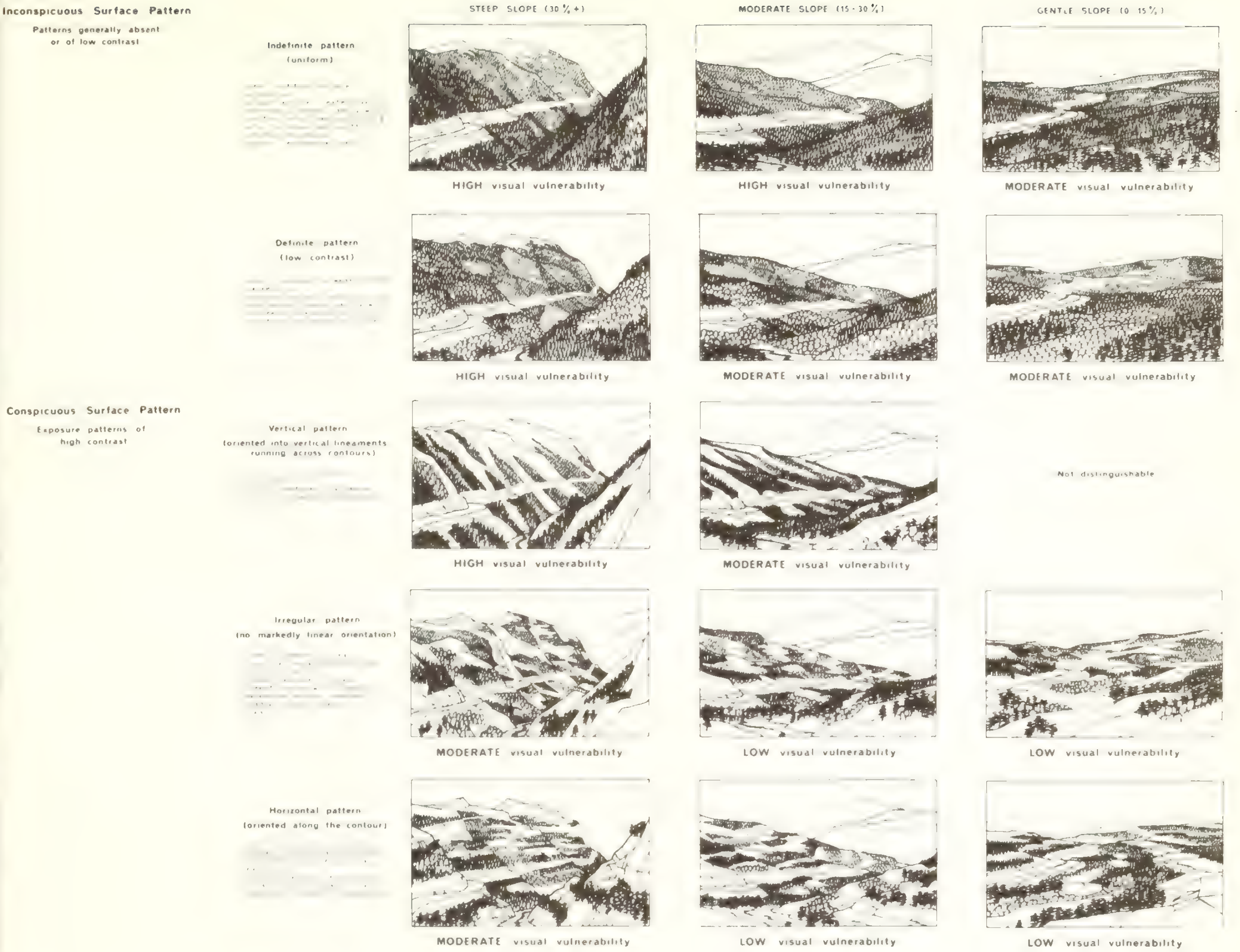
Inconspicuous Surface Pattern
Patterns generally absent or of low contrast
Conspicuous Surface Pattern
Exposure patterns of high contrast
STEEP SLOPE (30%+)
MODERATE SLOPE (15-30%)
GENTLE SLOPE (0-15%)
Indefinite pattern (uniform)
HIGH visual vulnerability
HIGH visual vulnerability
MODERATE visual vulnerability
Definite pattern (low contrast)
HIGH visual vulnerability
MODERATE visual vulnerability
MODERATE visual vulnerability
Vertical pattern (oriented into vertical lineaments running across contours)
HIGH visual vulnerability
MODERATE visual vulnerability
Not distinguishable
Irregular pattern (no markedly linear orientation)
MODERATE visual vulnerability
LOW visual vulnerability
LOW visual vulnerability
Horizontal pattern (oriented along the contour)
MODERATE visual vulnerability
LOW visual vulnerability
LOW visual vulnerability

Figure 5 -- Criteria for visual vulnerability assessment.

DISCUSSION OF THE METHOD

The method permits coordinated analyses at a range of scales. Visual units may be: 1) compared on a measure of inherent scenic value; and 2) grouped to display regional patterns of scenic value. At the site scale, derivation of visibility sectors, vulnerability assessment, and identification of scenic features provide detailed information for landscape management and design.

The concept assumes that observers are not limited to specific viewpoints. However, certain developments (e.g. townsites, overlooks) may require more precise visibility data than can be drawn from the visual unit maps. This demands considerable field-plotting or the use of computer programs to produce visibility maps (Travis, Elsner 1975) A recent study using VIEWIT, on a test portion of the Northeast Coal Study area, confirmed the general validity of the visual unit maps, in terms of general visibility.[5]

With respect to scenic distinction ranking, an assumption which may be questioned is that of representation of scenic value by a single number, located on an ordinal (ranking) scale, and derived by summing the scores of contributing factors. However, the summing of scores is the most direct method of taking into account all factors which are significant in forming a cumulative visual experience within a visual unit. It would be useful to establish index scores for regional landscapes against which the scores for particular units might be compared.

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[5] Fujioka, M., and S.R.J. Sheppard, 1979. An application of Computer Graphics to Visual Unit Analysis. Unpublished paper, Department of Landscape Architecture, Univ. of California, Berkeley.

The factors are scored by comparative evaluation from a qualitative graphic scale, and, hence no absolute quantitative relationship exists between the ranking scores of different visual units. The ranking system does not assert, for example, that a unit with ranking score of 100 is ten times as scenic as a unit with a score of 10. It aims instead to provide a relative scale on which regional scenic values may be ordered and compared, unit by unit.

Adverse visual impacts are considered only in one out of twenty scenic distinction factors, whereas their effects on the landscape may, in the extreme, be dominant. Future studies may require more complex assessment.

Visual vulnerability assessment, as presented here, addresses only two of the factors likely to influence visual impact. Ideally, technical information on soils, terrain, vegetation. regeneration rates, and climate should be included.

It is expected that extension of the methodology may be necessary to meet the demands of new studies. It must be emphasized, however, that the visual unit concept remains useful regardless of the evaluation system employed.

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Enviroplan— A Summary Methodology for Comprehensive Environmental Planning and Design[1]

Robert Allen, Jr., George Nez, Fred Nicholson and Larry Sutphin[2]

Abstract: This paper will discuss a comprehensive environmental assessment methodology that includes a numerical method for visual management and analysis. This methodology employs resource and human activity units as a means to produce a visual form unit which is the fundamental unit of the perceptual environment. The resource unit is based on the ecosystem as the fundamental unit of the physical environment. The human activity unit is based on the activity setting as the fundamental unit of the behavioral environment. Therefore, the enviroplan methodology allows the simple integration of environmental process with the purposes of people by reducing a complex process to its essentials.

INTRODUCTION

This methodology considers the environment as a single, whole process that is made up of physical, behavioral, perceptual, social and economic facets. Simply stated, it combines the physical and behavioral facets to form a perceptual facet. These serve as a medium for the actions of the social and economic facets. The subject for this case study is Daingerfield Island in Alexandria, Virginia, managed by the National Park Service as part of the George Washington Memorial Parkway (see Existing Conditions Map).

Before the physical and behavioral facets are combined, a ranked series of values is developed that provides a framework for the enviroplan process. This is an ordered arrangement of goals, objectives and criteria that ranges from general to specific.

ENVIRONMENTAL RESOURCE UNIT

The basic unit of the physical facet is based on the ecosystem and is called the Environmental Resource Unit. Its boundaries are based on those of the biotic community, and are modified by cultural features in relationship to physical properties. To arrive at boundaries for the environmental resource units, the physical, biological and cultural subsystems are mapped and described separately. The Physical Properties Map shows the general distribution of nonliving materials, with boundaries based on similar properties for geology, soil and hydrology formations. The Biotic Communities Map shows the patterns formed by living plants and animals, with boundaries based on common inhabitants of plant or ethnic communities. The Cultural Features Map illustrates all manmade or man-influenced characteristics, with boundaries based on similar properties with prehistoric, archeologic, historic and contemporary themes. The Ecological Systems Map summarizes these three subsystems and describes the site's resource units by naming the environment, its physical makeup, its dominant plants and animals, and its manmade facilities or man-affected areas (see Ecological Systems Map and Table).

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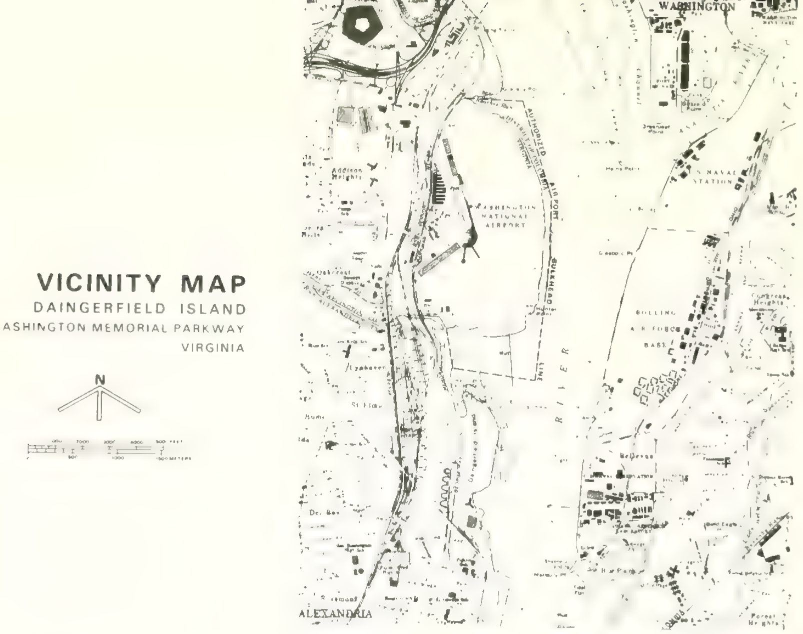
[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

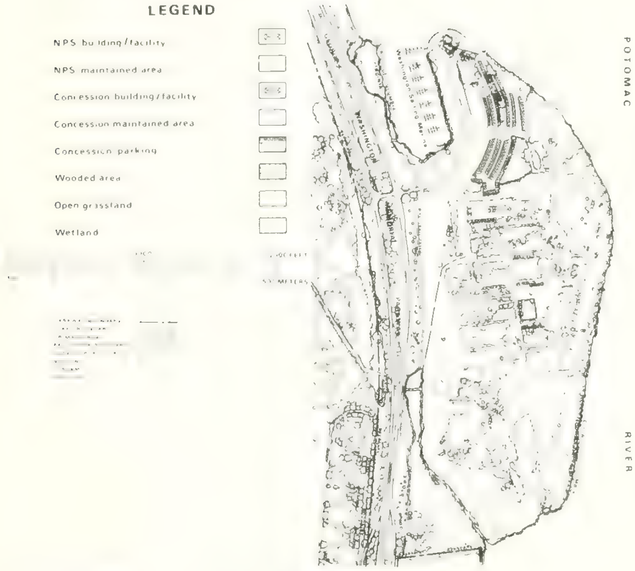
[2] Park Planner, Landscape Architect; Economist; Writer/Planner; Cartographic Technician; National Park Service, Denver Service Center, National Capital Team, Falls Church, Va.

VICINITY MAP

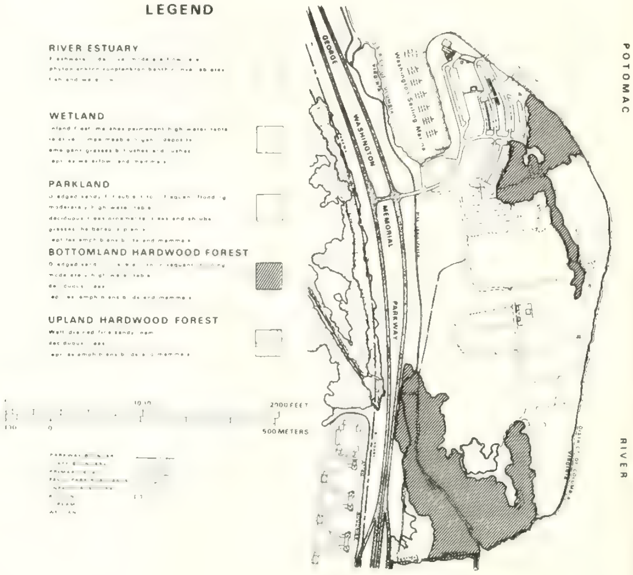
DAINGERFIELD ISLAND
GEORGE WASHINGTON MEMORIAL PARKWAY
VIRGINIA



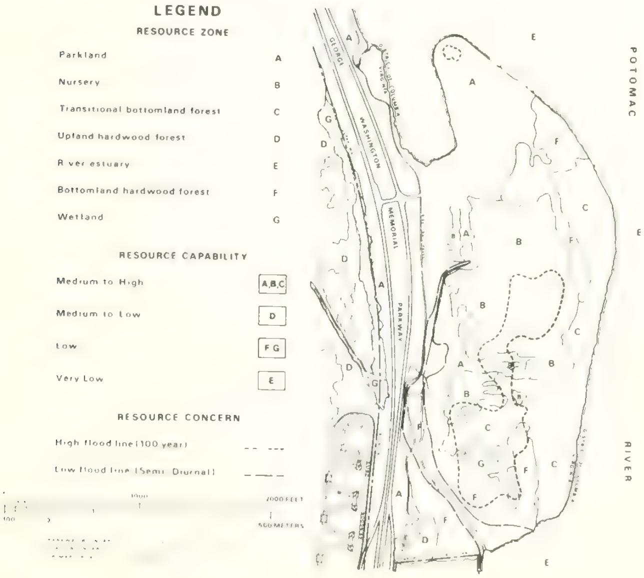
EXISTING CONDITIONS



ECOLOGICAL SYSTEMS

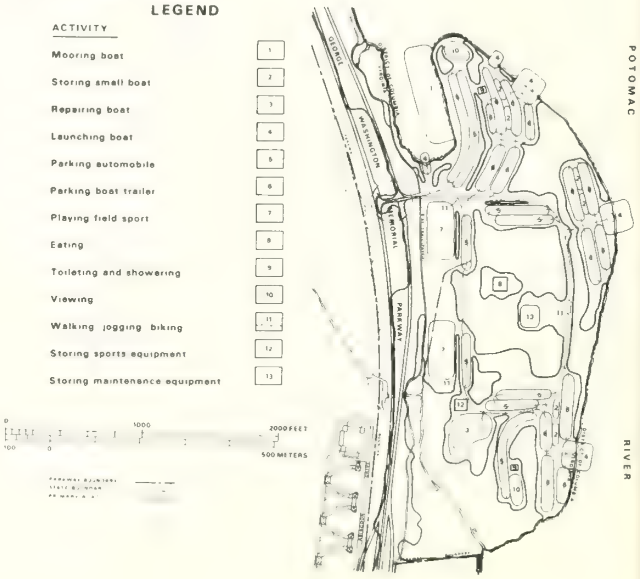


RESOURCE CAPABILITY AND CONCERN



Site Program

ALTERNATIVE 3



Because each resource unit (essentially resource zones) has characteristic properties for human use and development, the capability to support specific activities and facilities can be estimated. This means that common attributes affecting use and development within each unit can be judged and assigned a high, medium, or low rating. The resource units must then be adjusted or "fine tuned" to address any resource concerns. These concerns are vital, sensitive, or critical factors, such as flood-prone areas, that cross resource unit boundaries and therefore become important in estimating overall resource capability (see Resource Capability and Concerns Map and Table).

HUMAN ACTIVITY UNIT

Human purpose is combined with environmental process by a planned interrelationship of activities and their settings. The activity and its immediate environmental setting is a distinct unit that has social and spatial characteristics, and is the basic unit of the behavioral facet. User needs and desires are analyzed by using a matrix that compares proposed activities with 14 categories of characteristics for these distinct settings (for an excellent example, see Neighborhood Space, R. T. Hester, Jr., p. 121). The proposed activity zones, circulation flows and their spaces are distributed in relationship to the site's opportunities and constraints as shown on the Capability and Concerns Map (see Alternative 3 site program example).

SITE PROGRAMS

Different alternative site program diagrams can now be made with each showing specific proposed functions, circulation and space in their desired locations on the site. The Site Program Table details the proposed activity as well as the environment and management necessary to carry out each activity. This includes characteristics of the visual space, approximate area to be used by each activity, support facilities needed, density of use allowed, internal and external circulation linkages and construction costs for the proposed facilities.

An environmental impact matrix can also be prepared that compares the resource zones with the activity zones. The resource zones are grouped according to land or water capability. The activities are organized in categories such as built facilities, visitor services and circulation. The possible degree of environmental consequence includes minimal, moderate and major impacts. Also, a Resource Area Table shows the approximate area and type of resource unit committed to each activity unit, in whole or part.

EVALUATION

The alternative models are evaluated and tested according to physical, behavioral, perceptual, social and economic criteria derived from the goals and objectives determined previously. The spaces and configurations of the various alternatives will affect different activities in different ways, and the consequences can be evaluated for each criteria. These evaluations are organized into capacities, qualities and cost tables. A rating is assigned for each criteria and is weighted according to the relative importance of that criteria to the whole. An index number of "one" is assigned to one of the alternatives as a basis for a comparative effectiveness rating for qualities and capacities. Construction, operation and maintenance costs are determined for each alternative. A Summary Value Table compares the relative index numbers for qualities, capacities and costs for each alternative. The qualities plus the capacities divided by the costs provide a cost-effectiveness comparison of alternatives. Thus, the enviroplan process results in a numerical ranking of alternatives that contains comprehensive human purposes.

In summary, this methodology has the following applications:

> The resource unit and the human activity unit can be used to zone the site environment to show its approximate capability to support specific activities for use and development.
>
> The resource unit can be compared with the human activity unit to approximate the tolerable resource loading versus the tolerable visitor crowding and to determine a designed site carrying capacity.
>
> The resource unit and the activity unit can be compared to determine the approximate areas of each resource unit committed to each activity unit on the site, in part or in whole. The resource unit and the human activity unit can also be compared to determine a preliminary assessment of impacts.
>
> The interaction of the resource unit and the activity unit can be used to generate both visual form and to assign preliminary spatial design qualities to the site.
>
> The resulting spatial configurations and their connections can be judged according to the general amount of increase in social and economic interactions that may occur. A relative ranking of alternatives is accomplished.

Cost can be determined and assigned in order to accomplish an economic cost-benefit ranking of alternatives.

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The Mt. Mitchell Scenery Assessment[1]

Robert F. Scheele and Gary W. Johnson[2]

Abstract: The scenery assessment process for the Mt. Mitchell Suitability/Feasibility Study was conducted by National Park Service personnel and consultants in 1977-78. It combined approaches designed by Lewis (1962) and Jones (1976) in a comparative evaluation of the scenery of two large landscapes in the Appalachian physiographic province. The purpose of this study was to determine the degree to which parts or all of the ±245,000 acre study site surrounding Mt. Mitchell, North Carolina, satisfied national significance, natural area criteria for designation as a new national park. The design challenge required that the scenery assessment process be comprehensive, believable, efficient and that it aid the boundary definition phase of the study.

INTRODUCTION

Public Law 94-518 authorized the National Park Service to undertake a Suitability/Feasibility Study of a large area of landscape northeast of Asheville, North Carolina (fig. 1). Work on the study began May of 1977 and continued for a year. The primary purpose of the study was to explicate the significant resource values within the loosely defined boundaries of the study area and determine whether the sum of these natural attributes might qualify this landscape for inclusion in the National Park System. In some ways the search for resource values of scientific, historic, or scenic significance was a reversal of early Park Service studies which sought to define boundaries to protect landscape values which already enjoyed recognition, understanding and acceptance by national publics.

The study team included resource specialists from the Denver Service Center of the National Park Service, the office of the National Forests of North Carolina and the office of State Parks of North Carolina. The thoughts of private land owners in the study area were voiced through their Congressional representatives and the local media.

The inter-agency makeup of the team and the approach reversal spoken to above required that the subgroups of the study team be as objective as possible. Believability, or at least the expectation that the results of each substudy would stand the test of reasonableness was a goal to be achieved.

The scenery assessment sub-group designed the process which follows as a means of assessing the significance of the scenic aspects of study area landscape. We were guided by the recognition that in addition to seeking to be objective the method needed to be comprehensive, efficient to implement, and had to address head on the need for the results of the assessment to aid in the critical boundary definition phase of the overall study. As indicated above the authorizing legislation did not tie the study to specific and firm boundaries but rather to a region. Many local residents and resource users were concerned with this lack of specific study area definition and reacted quite naturally with fear and suspicion.

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[1] Submitted to The National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Associate Professor of Landscape Architecture, School of Natural Resources, the University of Michigan and consultant to the National Park Service; Landscape Architect, National Park Service, Denver, Colorado.

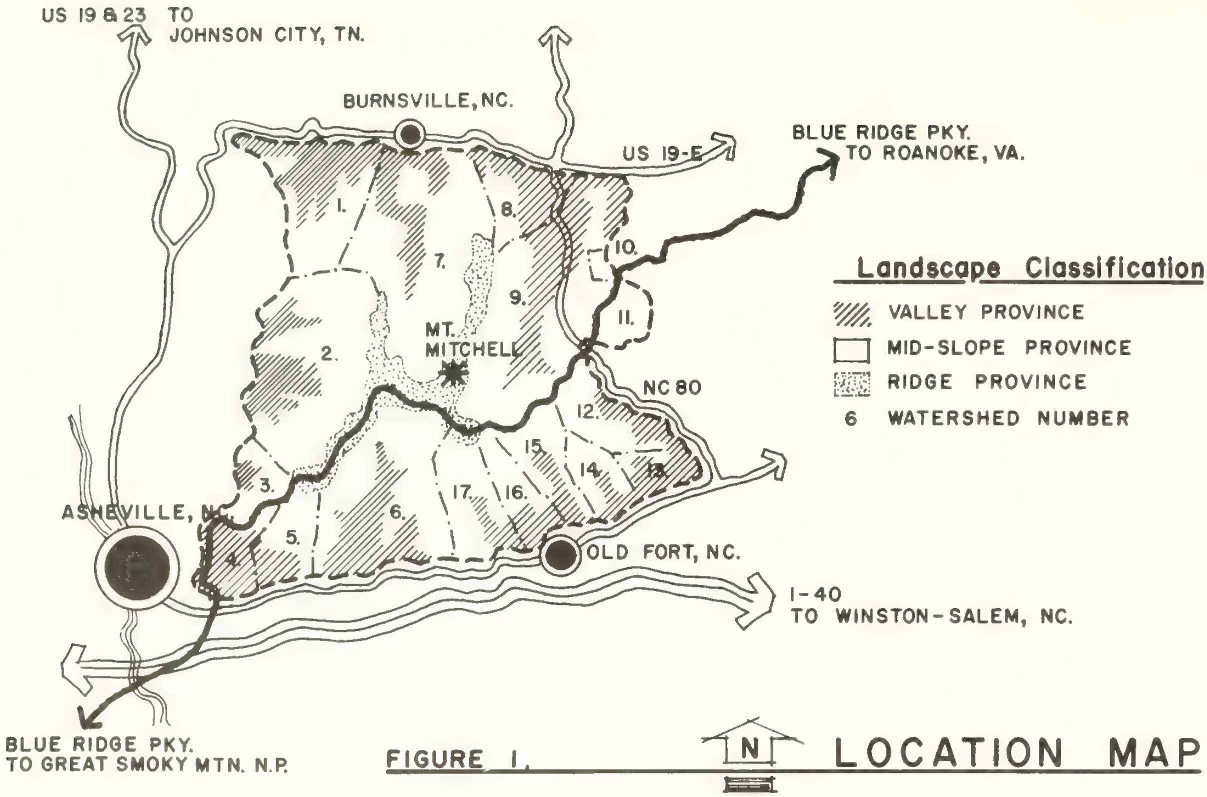


FIGURE 1. LOCATION MAP

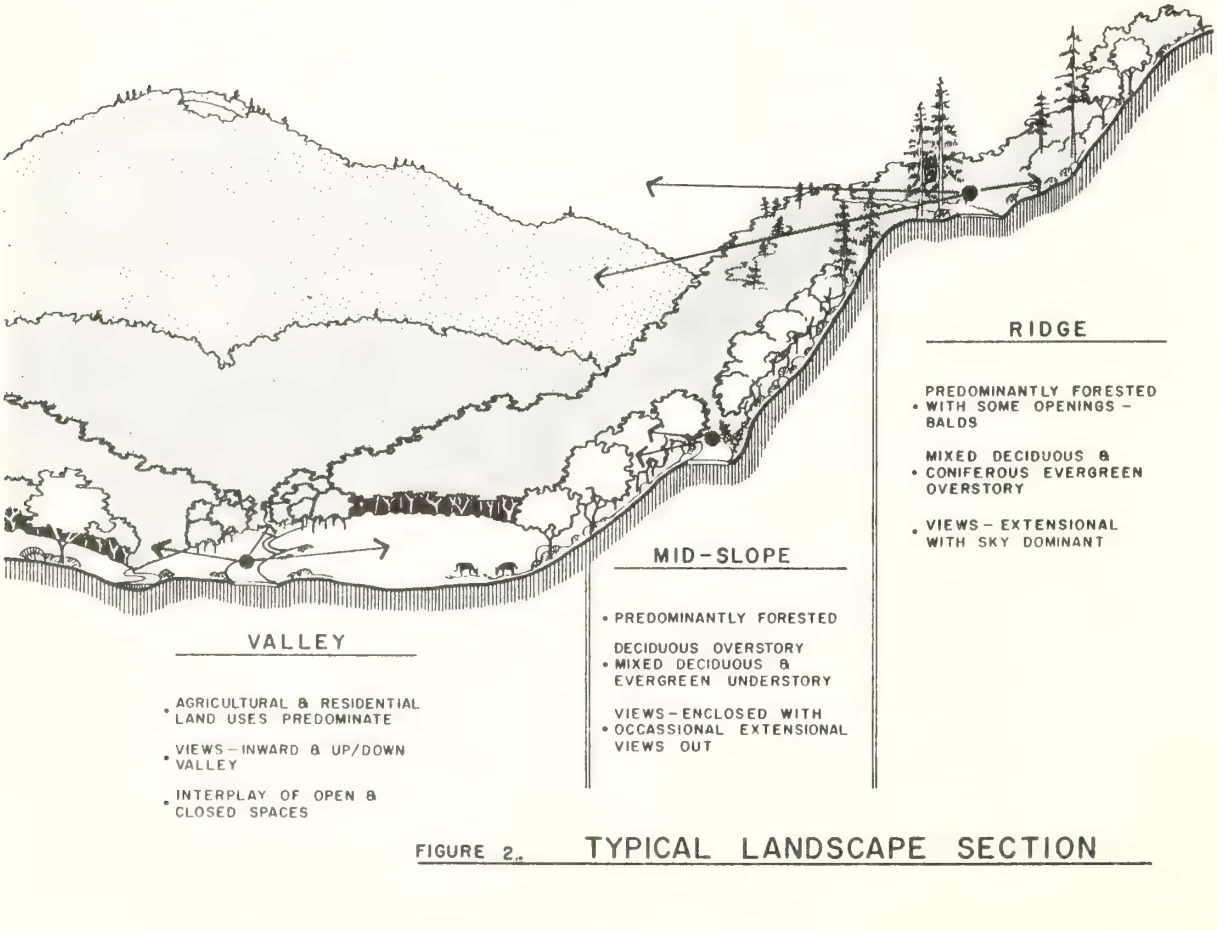

RIDGE
• PREDOMINANTLY FORESTED WITH SOME OPENINGS - BALDS
• MIXED DECIDUOUS & CONIFEROUS EVERGREEN OVERSTORY
• VIEWS - EXTENSIONAL WITH SKY DOMINANT
MID-SLOPE
• PREDOMINANTLY FORESTED
• DECIDUOUS OVERSTORY MIXED DECIDUOUS & EVERGREEN UNDERSTORY
• VIEWS - ENCLOSED WITH OCCASSIONAL EXTENSIONAL VIEWS OUT
VALLEY
• AGRICULTURAL & RESIDENTIAL LAND USES PREDOMINATE
• VIEWS - INWARD & UP/DOWN VALLEY
• INTERPLAY OF OPEN & CLOSED SPACES

FIGURE 2. TYPICAL LANDSCAPE SECTION

LANDSCAPE DESCRIPTION AND CLASSIFICATION

The study area encompassed approximately 245,000 acres. Mt. Mitchell, the highest land elevation east of the Rocky Mountains (6,684 feet) is near the geographic center of the area. Mt. Mitchell is part of the Black and Craggy Mountain Ranges of the Blue Ridge Province in the Appalachian Highlands (Fenneman 1928). The area is northeast of Asheville, North Carolina, and is bisected by the Blue Ridge Parkway. The dominant visual impression observers are likely to have of the study area landscape is on of large expanses of forested mountains and narrow valleys with suburban to rural development patterns in evidence.

A simplified landscape classification system based on a visual and elevational definition was developed to aid the inventory and analysis process. This classification identified landscapes as being in either the ridge, midslope or valley provinces. Figure 2 expresses the interrelationship of the provinces and also identifies some of the perceptual characteristics of each setting. It was within the ridge, midslope and valley provinces that the "corridor and observation point qualitative analysis" was performed.

A secondary classification by watersheds, 1-17 (fig. 1) was created to conduct the "interior potentials analysis." The dual system of classification-horizontal (watershed) and vertical (ridge, midslope, valley) aided comprehensive description and qualitative evaluations of the scenery.

THE SCENERY ASSESSMENT MODEL

Much energy has been spent in the past ten years in attempts to define and measure scenic quality. This has occurred for a number of reasons. Dominant among them has been the desire to bring scenic resource values to an equal footing with other more tangible resource values in the trade-off oriented management decision process. This desire has produced studies which purport to establish measures of quality which range from the documentation of individual expert feelings on the one hand to relatively sophisticated group preference testing on the other. At the time of the Mt. Mitchell study there was no concensus on the right method or participants or for that matter on the possibility or even desirability of attempting measurement. The National Park Service had no operational standards of scenic quality nor an accepted and uniformly applied process for measuring it on a relative scale. For the purposes of the study the following guideline was used:

> Qualitative evaluations of the visual resources of different landscape units must be based on inherent capacity to evoke perceptual response rather than on the subjective preference of the investigator, or even of the public at large. Preferences are culturally and historically conditioned, and as such are transitory: 'the mountain scenery , for instance, which many people now admire above all other, was once detested as dreary wastes'(Fairbrother 1974, p. 4). Preference testing is highly appropriate when used to prioritize the results of a resource-based landscape assessment. The resource-based assessment itself can attain a high degree of objectivity by breaking visual character into component elements, performing qualitative evaluations on these, and then recombining the results into an overall measure of character or value. A considerable degree of consistency in qualitative judgement between groups with markedly different preferences has been achieved with this

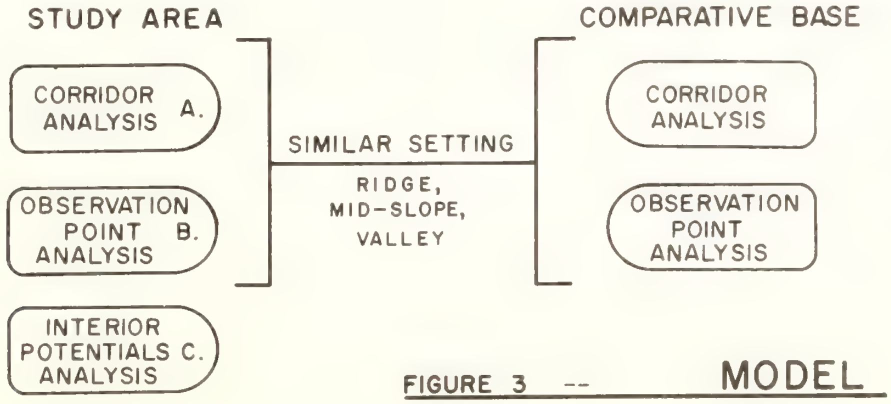


FIGURE 3 -- MODEL

method, which may be interpreted as an empirical demonstration of success " (Burnham et al. 1974, Hendrickson, et al. 1974, (Jones & Jones 1975).

The assessment model designed for the study involved the application of three analysis components, figure 3, to the study area. The results of two of them, 'A & B', were compared with the results of similar application to a landscape within the same physiographic province and of established national significance-The Great Smoky Mountains National Park. The process, modeled after the Scenic and Recreational Highway Study for the State of Washington (Jones 1976), involved evaluation of selected road segments and observation points within the 3 provinces-ridge, midslope, valley-of the comparative landscape and the acceptance of these ratings as quality standards. The ratings of similar segments within the provinces of the study area were then compared to these standards to determine the relative degree of difference between the two places.

These analyses were based on certain assumptions. First it was assumed that most visitors to the study area if it achieved park status would gain their impressions about the quality of the landscape from their automobiles while moving or stopped at observation points. The view from the road corridor, therefore, became very important.

It was also assumed that most visits to the area would take place in the summer and during the fall color season. Evaluations were therefore made during both seasons. Additional implicit assumptions had to do with the evaluator's objectivity, the typicalness of the time of year and day that evaluations were made, and the validity of the criteria and rating process used.

Data on the visual characteristics of the landscape were gathered in two ways; by observing while in a moving automobile and by photographing views at observation points.

Qualitative evaluations of the data gathered while driving were made immediately after the segment being evaluated was traversed. Evaluations of the photographs were conducted from mounted panoramas and projected slides within two months after the picture taking occurred. All evaluations were made by two trained observers. The evaluations were recorded on specially created forms (fig. 4).

It had been determined by others (Jones 1976) that three criterion values of visual quality are most important: the memorability of a scene or its "vividness," the wholeness of a scene or its "intactness,"and the harmony of its parts, "unity." The careful definition and scaling of these criterion values promised the possibility of retaining high degrees of objectivity in the evaluation of the visual quality of a scene or landscape type (i.e., ridge, mid-slope, or valley). The averaging of the ratings given these three criterion values became the "score" for the view of corridor segment being rated.

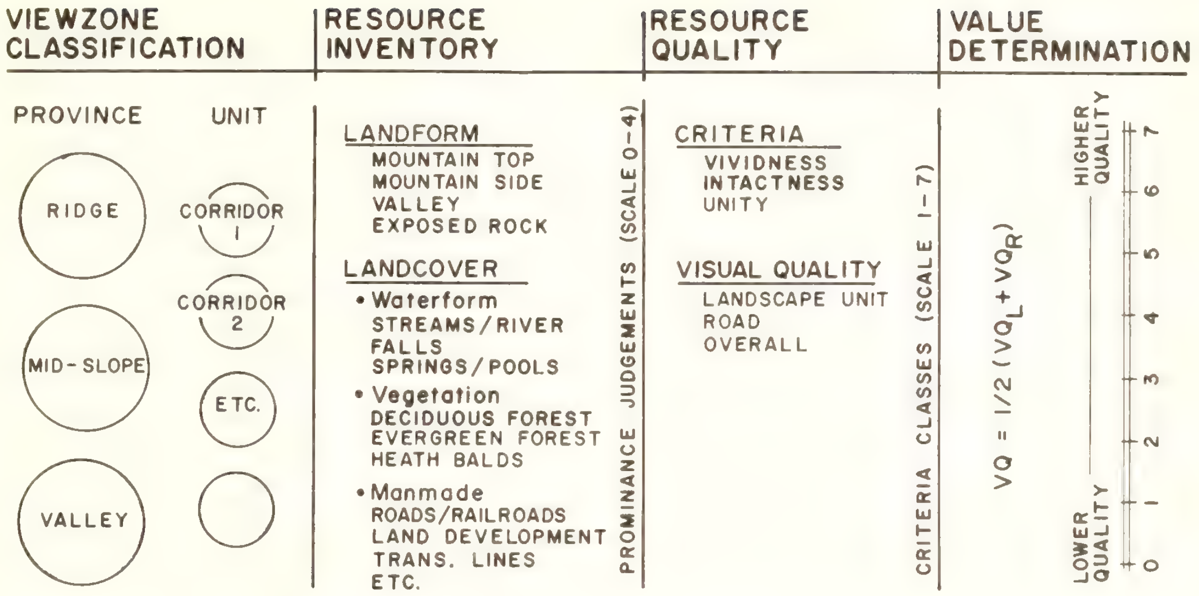
The definitions of the criterion values are:

> Vividness: A measure of the distinctiveness, diversity, and contrast of the visual impressions derived from the qualitative assessments of landform, waterform, vegetation and man-made form and their prominence within each segment.
>
> Intactness: A measure of the degree of natural condition of the landscape, derived from "development"-- the degree of landscape modification by man, and "encroachment"--the degree of visual disruption.
>
> Unity: A measure of compositional harmony, derived from the congruence of man-made forms with nature and the overall unity of the elements of the view.

The third analysis component of the scenery assessment model, 'C,' was applied only to the interior reaches of the study area. This procedure was modeled after that designed by P. H. Lewis, Jr. to estimate the recreation value, based partially on scenic quality, of large landscape areas (Lewis 1962).

The analysis was designed to expose qualitative differences between the 17 watersheds of the study area to aid the boundary alternative identification process.

The 12 scenic resources which were inventoried and mapped fit into water, land and vegetation categories (fig. 5). The basic proposition was that watersheds which possess large amounts of these scenic resources--preferably in close proximity to each other--have higher scenic quality than those which don't. By extension, those watersheds with "low" amounts of scenic resource would be candidates for exclusion in a process which tried to include the "best," most scenic,



BASIC PROPOSITION IS THAT A LANDSCAPE EXHIBITS HIGH SCENIC QUALITY IF ITS RESOURCES ARE PROMINANT AND DIVERSE, MEMORABLE, AND EVIDENCE INTEGRITY AND UNITY.

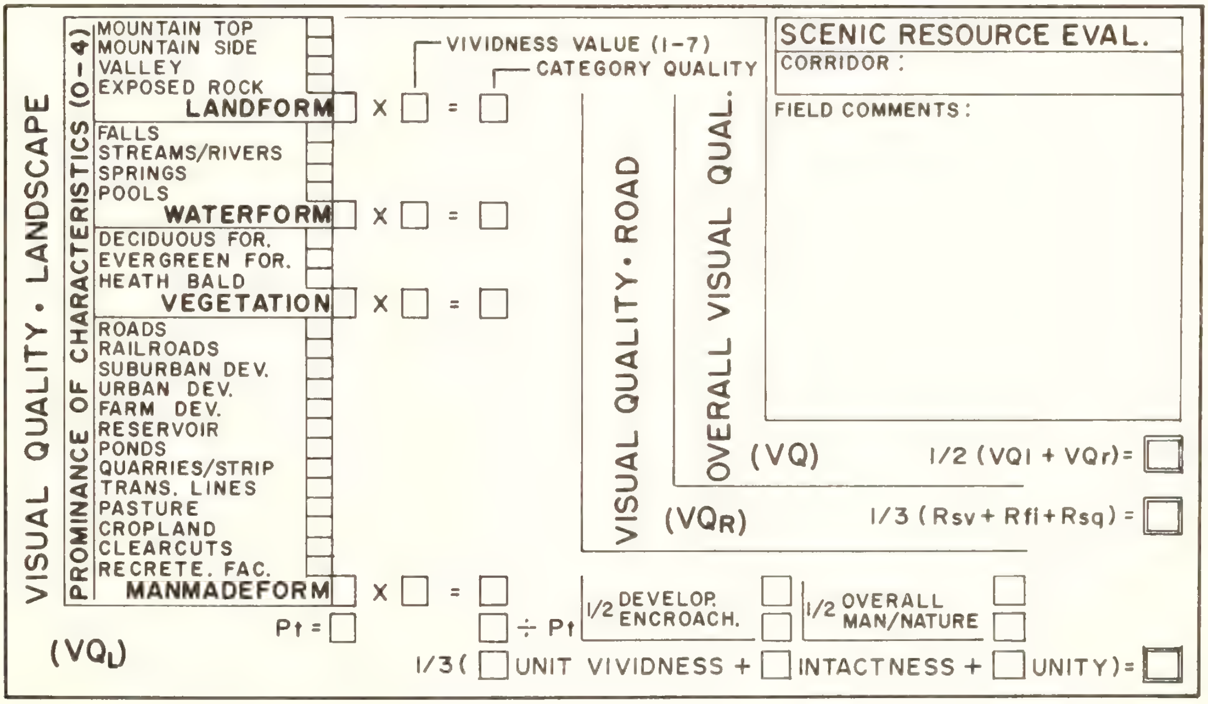


FIGURE 4. COMPONENTS A & B

INTERIOR POTENTIALS ANALYSIS *

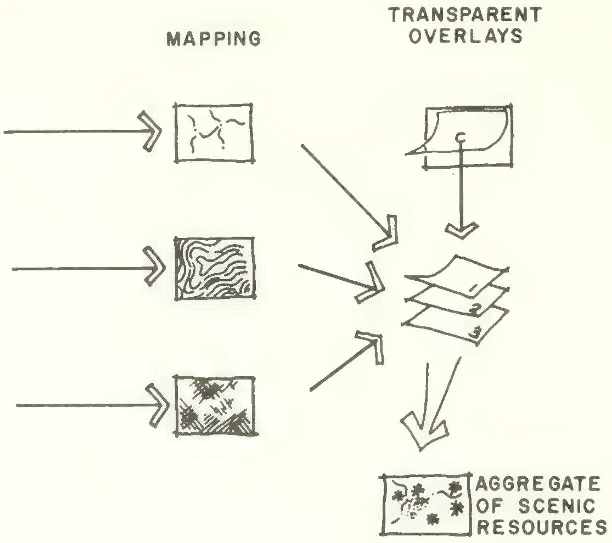
PROCESS DEPENDENT ON INFORMATION FROM ENVIRONMENTAL SPECIALISTS.

- NATURAL RESOURCES OF HIGH SCENIC QUALITY POTENTIAL

WATER
CLEAN STREAMS & LAKES
RAPIDS–WHITEWATER
NATURAL SPRINGS
UNDISTURBED WETLANDS
STREAM CONFLUENCES
WATERFALLS

LAND
STEEP SLOPES
ROCK OUTCROPS – CLIFFS
HIGH POINTS
TIGHTLY ENCLOSED SPACES

VEGETATION
MAJOR ECOTONES
MEADOWS
BALDS
UNIQUE SPECIES



- CULTURAL RESOURCES OF HIGH SCENIC QUALITY POTENTIAL

BASIC PROPOSITION IS THAT LOCATIONS WITH AGGREGATED RESOURCE VALUES HAVE GREATEST POTENTIAL OF PROVIDING A HIGH QUALITY SCENIC EXPERIENCE.

* SYSTEM MODELED AFTER P.H. LEWIS JR. RESOURCE INVENTORY PROCESS.

FIGURE 5. COMPONENT C

in Park System boundaries. Judgments about the aggregated resource values as they are distributed in the landscape were expressed relatively.

The primary sources of information for this component included U.S.G.S. Quad sheets 1:62500, color aerial photography from a 1972 flight, and the maps and reports of the other team members. The mapping on overlays was conducted in the office. There was inadequate time to field check the results. Thus the use of the word "potential" in the component name.

In summary, analysis components 'A & B' yielded information on the scenic quality as seen from the road. Analysis component 'C' predicted the scenic quality potential of the interior landscapes - those not seen from a road.

FINDINGS

Components A & B

The process display (fig. 4) indicates that the formula $VQ = 1/2\ (VQ + VQ_R)$ (Jones 1976) was applied to synthesize the segment ratings into a segment score. The scores were compared, province by province, with those of similar segments in the Great Smoky Mountains National Park. This comparison indicated the position of the study area province being analyzed with respect to the comparative standard when both were arrayed on a lower to higher, 7 level relative quality scale. The following tabulation results from summing and averaging ratings of all segments in each province in the study area and comparative landscape in two seasons.

	Summer	Autumn	Mean
Component 'A'			
Corridor Analysis			
Average value Smokies	5.0	6.0	5.5
Average value Mitchell	3.9	4.8	4.4
Component 'B'			
Observation Point Analysis			
Average value Smokies	5.3	6.3	5.8
Average value Mitchell	4.3	5.3	4.8

As can be seen and as expected the scenic quality ratings are higher for the comparative base than those of the study area. A review of the pertinent field rating forms indicated that the study area generally received lower ratings in the valley province under the criterion values of intactness and unity. The fact that the valley provinces of the study area, especially those south of the Blue Ridge Parkway, are undergoing rapid unplanned land use change from rural to suburban type uses is no doubt the reason for the lower scores.

Component C

The scenic resource values mapped for the study area tended to aggregate in the upper reaches of the mid-slope and ridge provinces. As a pattern this distribution attributed no relative advantage to one watershed over another.

The even distribution of scenic resource potential in the higher elevations and the higher and comparable (with the landscape of national significance) scores of road segments in the ridge and midslope provinces suggested boundaries be established which included the landscapes above the valley province.

SUMMARY

This scenic quality evaluation set about to explicate the attributes of the Mt. Mitchell study area and, also to discover the relative degree of sameness between the study area and the regionally significant landscape of the Great Smoky Mountains National Park. The procedures used to accomplish both of these goals were comprehensive in design and systematically implemented. Relative quality rankings were produced. It was found that the higher reaches of the Mt. Mitchell study area compare favorably to similar settings in Great Smoky Mountains National Park and also possess the highest aggregation of scenic resource values.

The results of the studies of the other resource specialists also tended to place value on the higher areas. In combination the findings led to the creation of 6 management alternatives for midslope and ridge provinces of the study area. A Congressional decision on the management designation for this landscape has not been rendered at the time of this writing.

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Landscape Maps as an Aid to Management of Scenic Mountain Areas[1]

Roland Baumgartner [2]

Abstract: Before any question about wise management decisions concerning the visual resource of our environment can be answered, it is necessary to conduct a detailed analysis to determine the integral visual inventory of landscape, as it impresses any involved person. With this method of landscape analysis researchers and planners can specify the potential of any region with an approach suitable for the problem. The knowledge about visual landscape elements is, in addition, a requirement to comprehend their influence on the motivation of any visitor or inhabitant.

INTRODUCTION

This paper discusses landscape analyses in the Swiss UNESCO MAB 6A Program [3] (Impact of Human Activities on Mountain Ecosystems), and in the Indian Peaks Region of the Colorado Front Range. It covers the Swiss Diploma work of Roland Baumgartner and also provides an outline of research recently initiated in the southern Rocky Mountains which will later be continued as part of the Swiss MAB Program. The Indian Peaks section of the Colorado Front Range has been selected because it is the object of an intensive study by the Institute of Arctic and Alpine Research (INSTAAR). This study will result in production of an Environmental Atlas for a newly created Wilderness Area in the Indian Peaks and a contiguous UNESCO-MAB Biosphere Reserve (Niwot Ridge). The work is a team study supported by a research grant from the National Aeronautical and Space Administration (NASA) to J.D. Ives (Principal Investigator). It is part of a NASA program to study the applications of space technology to the solution of land-use problems.

The two studies, Aletsch (Switzerland) and Indian Peaks (Colorado), will be expanded later as a combined Swiss - United States MAB 6 undertaking, a study of the impacts of human activiti on mountain ecosystems.

SET OF PROBLEMS AND OBJECTIVES FOR THESE LANDSCAPE ANALYSES

Since the middle sixties the functions and processes in natural landscape systems have been increasingly studied by university institutes an by different agencies as a specific new branch o environmental science, called "Landscape Ecology These approaches are consequently directed to solve capability problems (suitability of region as settlement places, as recreation areas, etc.). Besides traffic, energy, mining, air pollution and so on, the potential of landscape experience for every involved person has been elaborated as one of the principal factors of natural applicability. One problem seems to be neglected quite often in this context. Many studies are restricte to only a few visual factors and elements, which appeared in the initial stages as if they would be dominant. They were used to solve the question about the theoretical capability of a region. But, these factors usually cannot characterize th landscape as an integral whole and critical exami nation of the applicability is therefore mostly too specific. For example, either vegetation or relief or scenic views have been taken into con sideration only as single aspects. Researchers an planners have been mapping ecological data in a "single disciplinary manner." At the present time no one is analyzing and interpreting the overall visual aspect of the environment.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979. Contributions to the Swiss UNESCO MAB-6 Program and to the Indian Peaks Environmental Atlas.

[2] Coordinator for the Indian Peaks Environmental Atlas. Visiting Research Fellow, Institute of Arctic and Alpine Research (INSTAAR), University of Colorado, Boulder, Colo. 80309. Home Institution Geographical Institute, Berne University, Switzerland.

[3] UNESCO Program "Man and the Biosphere(MAB)".

As the sub-title of our National Landscape Conference says, we are attempting to summarize the available applied techniques for analysis and management of the visual resource. Before any management decisions, or any qualifications about the value of a visual environment can be made, it is necessary to conduct a detailed analysis to determine the integral inventory of the visual landscape aspects as they impress different groups of involved people.

The goals of our landscape studies include the following:

- First, that the Basic Maps, when compared, provide a check on the effectiveness of different mapping approaches to facilitate perception of various visual aspects of landscape. They also provide accurate information about mutual dependences of natural and man-made factors. This work has been accomplished in the Aletsch Region and is described in the section on Basic Maps (fig. 1 and 2).*
- Second, the combination of visual aspects into one map, showing "Combined Dominant Visual Landscape Types" is an experiment to determine landscape units (classes) as integral over all relevant elements for the perception of the visual landscape. These data have already been utilized as an invaluable component in completing the "Rocky Mountain National Park Comprehensive Boundary Study Report" to the U.S. Congress. This step is also an indispensible basic requirement to extract elements which are significantly influencing involved people in their motivation and thinking about a region. This work is being conducted in the Indian Peaks and is discussed in the section on Combination of Aspects.

BASIC MAPS: PERCEPTION OF A MOUNTAIN LANDSCAPE

(Study Area: Aletsch Region, Switzerland)

The initial landscape analysis produced three basic maps (slope, geomorphology, and land use) which present three aspects of the environment from three different points of view. The idea to produce these landscape maps comes from the three main approaches to geography:

a) formal/descriptive studies, which characterize landscape forms and structures most objectively by measuring, counting, or simply characterizing certain features by a concrete description (e.g., a certain slope has a certain angle of inclination and is composed of a certain material with a certain grain size);
b) genetic/historical studies, which tell about the origin and historical development of the landforms. This approach corresponds most appropriately to the mathematical term of a "function." Landscape is therefore "a function of different factors" (e.g., this slope is a glacial deposition site and is caused by glaciers' moraines);
c) functional studies, which, in contrast to the genetic/historical studies, "look forward They elaborate the uses of a certain element by telling us how it is used today, and what former uses are still obvious, as well as what uses it is developing toward. Landscape has in this case "the function that..." (e.g., this approach informs us that the above slope is a former grazing land, now abandoned, and its appearance results from this fact).

Objectives and Specific Results of Each of the Three Basic Maps

The slope map -- The slope angle is obviously one of the most efficient criteria to typify a natural mountain landscape and to interpret land use. It is also significant in characterizing relief , and both recent and former processes. Slope maps provide the best description of mountainous landforms: terraces, gentle ridges, large valley bottoms, and deposition areas are distinctly separated from steep slopes, V-shaped valleys, and rockfall areas.

The geomorphological map -- (see also figure 2*). Its aim is to give detailed information about the origin, structure, genesis and dynamics of the landscape's surface. This map is not comparable to a complete morphologic, morphogenetic or even morphodynamic study because of its orientation to visual features only (e.g., the structure and composition of surficial deposits are only relevant if they are influencing the surface expression of today's landscape).

Figures 1* and 2* show the landscape of Martisberg, Aletsch Region, Switzerland, on a photo taken from the opposite valley side and on a part of the "Geomorphological Map Aletsch." The photo to the left provides particular information about actual land use patterns; it gives an idea about the functions of the different areas: traffic and intensive agriculture in the valley bottom, settlements and quite intensive agriculture on the gentle, unwooded slopes, and alpine pastures around and above treeline. The forest covers steep slopes and jagged V-shaped valleys edging the cultivated land. Avalanche and erosion paths can be observed in the forest areas.

The Geomorphological Map (right photo), however, defines the origin of the different landscape types and their uses: moraine deposits are to be found in the cultivated areas, and rough weathering and its deposits in the small valleys. Subsidence causes the terrace for alpine pastures and for possible tourist settlements.

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*See color illustration on page 388.

The following type of legend has been used to determine "Morphological Landscape Types" in the Aletsch Region:

215	Subsidence area	
V	Outcrop bending	
216	Deep weathered bedrock	
X	Disrupted rock	
▲	Bare bedrock, not disrupted	
231	Detrital material	
△ ▲	Boulders	vegetated/
⊡ ■	Debris slope	no vegetation
237	Alluvial plain	
241	Moraine material	
242	As 241 but affected morphodynamically	
▲▲▲	Moraine hill	
⊙ +	Exposure/Erratics	
251	Actual morphodynamics	
↱	Landslide	
S	Abrasion by snow	
271	Avalanche path (in forest areas)	
⋰	Debris cone	
— — —	Gully erosion	
↦	Cattle paths	
≡	Wet area: depression	
≡	Wet area: source	
A	Forms caused by man	

The most striking characteristic of this map is the good division of this mountain landscape. Many of the well-known types of landforms are defined scientifically. This kind of study awakens the comprehension of landscape development and its causing factors. It gives an idea about "Landscape Ecology."

The land use map -- The Swiss MAB Program applies basically the following essential functions for a mountain area: protection (from natural hazards, but also in the sense of protecting the natural ecosystem), revenue from natural resources (agriculture, forestry, energy, water supply, mining, etc.), and recreation (general attractiveness for inhabitants and visitors). The objectives of our land use map are to answer these questions: "How is this area developing (naturally or caused by man)?" or: "What is (or was) it used for; what production aspect does it provide?" The "functions" of the earth surface are therefore: natural (natural vegetat or vegetationless); caused by man (cultivated land for forestry, settlements, etc.); or formerly influenced by man and now abandoned.

The land use map should be complementary t the slope and geomorphological map. It should, when compared with the first two maps, show which main uses were possible in past times und natural conditions and which ones are feasible today, as well as what processes might occur if the exploitation is changed. This kind of land use map does not describe the theoretical, or general potential of the landscape. It gives useful aspects about the land's capability by describing patterns which are exclusively appearing visually.

For the Aletsch area agricultural use was the most obvious feature for a "functional map' (see introduction to Basic Maps). But this syst of mapping is open to all kinds of land types, natural or man-influenced, so it can be used easily in other regions.

THE COMBINATION OF DIFFERENT VISUAL LANDSCAPE ASPECTS INTO ONE MAP, SHOWING COMBINED DOMINANT VISUAL LANDSCAPE TYPES

(Study Area: Indian Peaks, Colorado)

First, this step describes completely the visual impression of the "natural landscape" on a visitor or inhabitant, although it does not address how the landscape is interpreted (landscape is, in contrast to the Basic Maps, displaye as an integral,over all relevant visual factor.

Second, this research is the indispensable instrument in analyzing the different "formal elements" (like single trees, solifluction forms spectacular viewpoints, look-outs, etc.) to comprehend their influence on the motivation of groups of involved people. That qualification of landscape elements provides valuable information for future decisions about landscape development plans.

As derived from the Basic Maps, the Dominan Visual Landscape Map can show either abiotic features, biotic ground cover, man-made or influenced aspects of a combination of these.

Geology, Geomorphology, and General Relief Characteristics as Shaping Factors

The principal structure of every landscape is mainly caused by its mode of formation. Different crustal movements lead to differences in elevation. Weathering, erosion and deposition of material then form the relief existing today. Each shaping factor leaves its specific features: weathering on bare rocks varies strongly from that on detrital slopes; or glacial cirques never look the same as a region of lateral or terminal moraines.

In this manner the following geological/ geomorphological criteria were taken into consideration:

a) main topographic features of the area (macro relief: canyons, gentle ridges, plains, etc.)
b) micro relief (areas with or without often changing relief: active or inactive geomorphic processes)
c) slope angles and combinations of them
d) structure and composition of the ground surface (bare rock, weathered or deposited material, etc.)
e) typical features, obviously telling about genesis (detrital fan, moraine, rockfall, etc.)

However, these criteria need only be applied if the resultant features really become apparent as dominant visual aspects in a certain landscape unit.

Forest, Other Vegetation and Human Impact as Shaping Factors

In addition to the abiotic features vegetation is in most areas also critical to the visual interpretation of landscape types. The following visual characteristics have been used to specify "Dominant Vegetation Landscape Types" in the Indian Peaks:

a) type of closed forest (conifers or leaf-wood)
b) density of trees (open/closed forest, timber line, clearings, etc.)
c) bushes (type, density, bushes along with other vegetation, etc.)
d) grass cover (type, density, along with other vegetation, impaired by geomorphic activity, etc.)

In many regions, human land use has become even more significant for landscape characterization than the natural vegetation. Not only have agriculture and forestry changed our environment but also road construction settlements, and, especially in alpine regions, tourist installations have produced an evident impact. In this sense there is a major contrast between the Aletsch Region and the Indian Peaks area, where the latter is more nearly unchanged by man (in the Indian Peaks human impacts are shown by the symbol A, complementing dominant natural landscape units). The different vegetation features in the map of combined landscape types can be varied, but one visual aspect can generally be called dominant.

The Dominant Landscape Types (see Figure 3*).

The landscape type map of the Indian Peaks area is a combination of either dominant geological/geomorphological or dominant vegetation units or an association of both. In other areas like the Swiss part of the European Alps, man-made or influenced features would have to be taken into consideration much more. What does "dominant" mean in this case and how are these landscape types selected?

First of all, several maps have been compiled from air photographs and satellite imagery and from field work in the Swiss Alps, on the Swiss plains, and in the Indian Peaks. These maps are intended to show identical visual landscape types. First they are designated only by numbers, without mention of the different factors (geology, vegetation, etc.) producing different aspects. From these a large matrix of "abiotic elements versus vegetation elements" has been constructed. The following main landscape components have then been selected out of this matrix for a map of "Combined Dominant Visual Landscape Types" in the Indian Peaks. A prototype of the Combined Dominant Visual Landscape Type Map showing the region between Monarch Lake and the Continental Divide, Indian Peaks Wilderness Area, Front Range, Colorado, is displayed in the separate photo part of this paper as Figure 3*. This map displays only a small region of an area that is 200 square miles in size, and which has been determined to be the main study area for the forthcoming Indian Peaks Environmental Atlas. This kind of information is, as already mentioned, used in compiling the report about the suitability of revising the boundaries of the Rocky Mountain National Park.

Below Timber Line:

CO	Conifers, closed forest; all abiotic features in that unit are less relevant than the "closed forest aspect."
AS	Aspen, closed aspen area; all abiotic features and conifers are less relevant than the "closed aspen forest aspect."
CL	Clearing in closed forest areas (either conifers or aspen), caused mostly by human impact (timber cutting, agriculture, etc.). No abiotic features are dominant because of surrounding forest.
ST	Sparse forest areas, caused by moisture, human activities, or other factors (other than bedrock)
SR	Sparse forest areas, caused by association with rock outcrops. "Forest impression" is still relevant. Comparable to FT.
LB	Large valley bottom. Colluvial or alluvial area, at least 100 m large, mostly with creek

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*See color illustration on page 388.

and relatively wet. Always covered by grass (forest in valley bottoms is mapped as "CO" or "AS").

CY Canyon or v-shaped valley. Strong downcutting by water; steep slopes, rough rock. "Forest aspect" not relevant.

Above Timber Line:

FT Forest-Tundra ecotone (tree-line zone). Mapped only if aspect of the forest below remains (if not look for units with the single trees symbol).

AV Alpine valley floor with typical high mountain character, mostly with large differences in relief downvalley.

GR Vegetated, mostly gentle ridges or slopes, covered by tundra (more dense than SS). Genesis: geological, periglacial, and/or solifluction; no big differences in relief, no boulder or large bedrock areas; detrital material visible in areas where the tundra is impaired.

SS Partly vegetated slopes. Some detrital material; slopes without large differences in micro-relief, covered with dense tundra ± (mostly less dense than GR); geomorphic movement partly apparent; no entire detrital slopes or block/boulder fields.

DS Detrital slopes or fans, mostly composed of material less than 50 cm in diameter; only very sparse vegetation possible because of heavy geomorphic activity.

BF Block/boulder fields on slopes or plain surfaces, material greater than 50 cm in diameter. Genesis: rockfall, solifluction, or weathering in situ in big blocks; only sparse vegetation (less than 50% coverage).

BB Mixed bedrock bolcks and vegetation in between, large differences in micro-relief; either scoured by glaciers or the result of rough rock weathering.

RR Bare bedrock, rock walls or couloirs, mostly steep areas, rough weathering, no scouring ("climbing rock"); source areas of detrital slopes, or fans and boulder fields (rockfall).

GS Glaciers, or year-round snow.

So as to avoid losing too much detail and to have the possibility of mixing different features of the legend, several symbols (indices) have been added to specify the 13 dominant landscape types. These symbols represent only a selection of all the indices already used, and more may be added in the future:

| single conifers

↑ single aspens

⊙ small clearing

— linear clearing in forest

✓ sparse grass/tundra

≡ wet depression

× bare bedrock

-×-× couloir on bare bedrock

---- linear erosion in detrital material

—-- linear erosion covered by vegetation

⋰ detrital slope/fan

•- big single boulders

The very thick black line on Figure 3 is the Continental Divide; the less thick shaded line shows tree line. All colors in red specify rock features; gray indicates accumulation areas; blue shows tundra; and green shows wood. The yellowish means a clearing, or open forest.

MOTIVATION RESEARCH TO DETERMINE THE VALUE OF THE DIFFERENT LANDSCAPE ELEMENTS

A Continuation of our Landscape Studies in 1979 and 1980

(Study Areas: Colorado and Switzerland)

A survey of people using the mapped areas will determine which landscape elements (from the Combined Landscape Type map) cause which kinds of response to the natural environment. This evaluation will show the planner which of these factors are most important in classifying the regio as an estimable living or recreation area.

Next, the transformation of existing development plans (timber cutting, mining, roads, settlements, or tourist installations) into simulated, potential manifestations allows one t perceive visually how this environment could be changed. A second survey following this will provide even more detailed information about the real value of the various elements to the differe groups involved. People will tell us which change they accept and which they consider as a significant damage to the visual aspect of a scenic natural landscape. This approach to landscape aesthetics is a major input for management policy-making. In this way one should be able to consider which elements are especially sensitive, i.e., which elements must be protected under any circumstance to preserve an unmodified natural landscape. Only this preservation will retain the high value in the classification of a region. By means of the second survey we can also form some very interesting conclusions about possible reactions of inhabitants or tourists to unwelcome changes in the environment.

SIGNIFICANCE OF THE RESULTS:
CRITICAL REFLECTION AND PROSPECT

Landscape maps make it possible to analyze and to characterize the environment from the visual and the aesthetic points of view. One learns a lot about the preferences of the different users concerning their classification of untouched natural landscape elements (positive and negative).

Through knowing the inventory of landscape features, and the expectations of inhabitants and visitors, as well as their reactions to landscape changes, one can provide useful information for landscape development and/or management policies in a given area. Such changes and policies should be accepted by all involved or interested people if they are to be successful. These results should then be used as a basis for planning and as a part of a "decision model" such as might be compiled by a group of researchers in the Swiss MAB 6A Program.

In addition, it is possible by collaboration with other scientists to contrast the evaluation of the visual aspects of landscape with economic and/or biotic factors. Every study pointing out stress limits in the socio-economic sphere or indicating "damages" in the natural ecosystem, would be related. This means that one would be able to prove if the different kinds of changesalso are perceived by involved or interested people as exceeding a visual limit of landscape.

ACKNOWLEDGEMENTS

This paper has been supported by NASA-PY grant number NGL-06-003-200 to J.D. Ives, and by the Swiss MAB 6A Program. The work in the Indian Peaks area has benefitted greatly through provision of satellite imagery and NASA Landsat underflight color imagery through the grant. The author also thanks J.D. Ives, University of Colorado, Boulder, B. Messerli, and H. Kienholz, University of Berne, Switzerland, and all members of the NASA-PY group for their comments on an early draft of this paper.

Technology Available to Solve Landscape Problems— Session B: Computerized and Quantitative Approaches

Policy Capturing as a Method of Quantifying the Determinants of Landscape Preference[1]

Dennis B. Propst[2]

Abstract: Policy Capturing, a potential methodology for evaluating landscape preference, was described and tested. This methodology results in a mathematical model that theoretically represents the human decision-making process. Under experimental conditions, judges were asked to express their preferences for scenes of the Blue Ridge Parkway. An equation which "captures," or defines the policy of each judge was generated. Individual equations were then clustered and a composite policy calculated at each step until one overall policy was obtained. The R^2's for some individuals were generally large (>0.50). However, composite R^2's were fairly low (<0.25). Methodological problems and management applications are discussed.

OBJECTIVES

The aim of this study is to examine the usefulness of a procedure known to industrial psychologists for approximately 18 years. This procedure, called "Policy Capturing,"has never been employed in the study of scenic beauty but seems to hold much promise. Specifically the objectives guiding this research are twofold: (1) to determine if Policy Capturing (PC) is a viable procedure for modeling the human judgment process regarding scenic beauty preferences, and (2) to identify and determine the relative importance of those landscape features which explain variations in scenic beauty preferences.

BACKGROUND

One of the more powerful analytic tools used to investigate landscape preference is multiple regression. The landscape preference studies which have used this type of analysis (Peterson 1967, Peterson and Neumann 1969, Shafer et al. 1979, Carls 1974; Zube, et. al. 1974, Arthur 1977, Buhyoff and Leuschner 1978) have generally shown favorable results. Multiple R^2 values have ranged from 0.330 to 0.988 with all but two R^2 values above 0.600. This indicates that the predictor variables studied have been able to account for much of the variance in landscape preference. Some researchers have extended the simple linear regression model to include nonlinear terms and parameters (Wohlwill 1968, Shafer et al. 1969; Buhyoff and Leuschner 1978).

Other researchers have voiced their criticisms of the multiple regression approach.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979. This study was funded in part by the U.S. Department of Interior through a contract with the USDI National Park Service, Southeastern Region, Atlanta, GA. The findings, opinions and recommendations expressed herein are those of the author and not necessarily those of the U.S. Department of Interior.

[2] Doctoral candidate in the School of Forestry and Wildlife Resources at Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. The author wishes to express his appreciation to Dr. Gregory J. Buhyoff for critiques of earlier drafts of this paper.

For instance, two of the strongest criticisms of the Shafer model (Shafer et al. 1969) and the multiple regression paradigm are the lack of any theoretical foundation (Kaplan 1975, Weinstein 1976) and the failure to account for individual differences (Weinstein 1976). Currently, there is no landscape preference theory per se. However, policy capturing, with its roots deeply embedded in the Brunswik lens model of behavior (Brunswik 1952, Hammond et al. 1964) and Hammond's Social Judgment Theory (Hammond 1955, Hammond et al. 1975), is a well-developed conceptual rationale for the use of multiple regression in any task involving human judgment. Landscape assessment is obviously one such task.

In terms of individual differences, "one of the purposes of using a linear model to represent the judgmental process is to make the judge's weighting policy explicit" (Slovic and Lichtenstein 1971, p. 678). Hence, one value of PC is that it allows the inference of an individual judge's policy by requesting an overall evaluation of a total stimulus (e.g., a landscape) rather than requiring evaluations of the elements making up that stimulus.

How Policy Capturing Works

PC analysis requires that a group of judges study the information relevant to a given situation and then make an overall judgment or decision based upon this information. A multiple linear regression model is then generated. The model identifies the informational cues considered by each judge and indicates how such cues must be weighted to simulate the judge's decision. Thus, the result is a statistical model which theoretically approximates how judges weight information cues (Bottenberg and Christal 1961, Christal 1968, Naylor and Wherry 1965, Dawes and Corrigan 1974). In this manner the researcher can generate a regression equation which "captures," or defines, the policy of an individual or group.

Clustering Method

Since policy capturing is aimed at revealing individual differences in judgment policies, methods for clustering judges on the basis of homogeneity of their equations have been developed. Ward (1961) and Bottenberg and Christal (1961) are generally credited with the initial work in this area. The clustering technique most commonly employed in the literature and the one used in this research is called the Job Analysis (JAN) technique (Christal 1963, Naylor and Wherry 1965).

In actuality, JAN is a two-step procedure. During the first step (JAN I) the input data are the values of the predictor and criterion variables. JAN I then yields as output the unstandardized regression weights, first-order validity coefficients (correlations between each predictor and the criterion), and the multiple correlation coefficient (R^2) for each judge's policy equation. If R^2 is relatively high, one can say that the judge's equation is reliable from judgment to judgment (Slovic and Lichtenstein 1971). The R^2 value also can be viewed as the extent of congruence between the linear equation and the inferential process of the judge (Goldberg 1970).

JAN II, the second step of the clustering procedure, receives as input the regression weights and validity coefficients generated by JAN I. During JAN II individual equations are combined one at a time and a composite strategy is calculated at each step. The clustering procedure terminates when all individual equations have been grouped into one composite policy. The loss in predictive efficiency (R^2) in going from individual to composite equations is a measure of the reliability of both individual and group policies. If the drop in efficiency is small throughout the clustering process, one can say that the individual rater equations are highly homogeneous (i.e., the judges tend to agree on the relative weighting of the predictors) and that the composite strategy is reliable (Naylor and Wherry 1965, Dudycha and Naylor 1966, Hamilton and Dickinson 1978).

METHODS

Stimuli

The stimuli for this study were 100 35mm color slides of landscape scenes taken from the Blue Ridge Parkway (BRP) between Waynesboro, Virginia and Asheville, North Carolina. Details on the composition of these slides and how they were selected can be found elsewhere (Propst 1979).

In order to carry out the PC procedure, one must first identify and measure the important elements of landscape preference. Harvey's (1977) work was used as a guide for selecting landscape dimensions. There were two reasons for using her research as a guide. First, Harvey used five methods (Thurstone's Method of Paired Comparisons, Likert scales, semantic differential scales, grid analysis and free response) to investigate the elements of landscape preference. Since the results of all methods tended to support each other, there is some convergent validity to her findings. Second, Harvey's slides and photographs were of BRP scenes.

This study employed 10 of the most important dimensions identified by Harvey: foreground vegetation, mountains, man-changed area, visible distant landforms, green colors, blue colors, unobstructed expanse of view, sky, clouds and undisturbed forest. The definitions of these dimensions can be found in the full study on which this report is based (Propst 1979).

A major reason for choosing only 10 dimensions is due to one of the limitations of PC. That is, to avoid overfitting regression equations it is recommended that each judge rate at least 10 stimuli per dimension (Naylor and Wherry 1965, Hamilton and Dickinson 1978). Ten such judgments are also necessary to insure sufficient variability along each dimension. With 10 dimensions and 10 stimuli per dimension, each judge had to rate 100 slides.

Subjects: Phase 1

The data for this phase of the study were collected during late spring of 1978. Subjects consisted of 225 undergraduate students enrolled in the introductory psychology class at VPI & SU. Based upon previous research results showing similarity in landscape judgments across groups (Wenger and Videbeck 1969, Daniel and Boster 1976, Zube 1974; Buhyoff and Leuschner 1978) it was not considered necessary for this exploratory study to sample actual recreationists or citizen groups.

Procedure: Phase 1

Each of 10 groups of subjects (n = 22 to 24 per group) rated a different dimension. For example, the first group was asked to rate the 100 slides according to the amount of foreground vegetation each scene possessed. The next group was asked to rate the same 100 slides according to the amount of mountains, and so on until all 10 dimensions were rated. A 9-point rating scale was employed with a "1" on this scale representing complete absence of a given dimension and a "9" representing almost complete coverage of the scene by a given landscape feature. In all cases, subjects were shown 5 practice slides which they attempted to rate according to the definitions given. Every effort was made to ensure that the subjects understood the instructions and the scale. Fifteen seconds were allowed per judgment.

Procedure: Phase 2

The 78 subjects used in this phase of the study came from the same subject pool describec in Phase 1. These subjects used a 10-point scale ranging from 0 to 9 to rate their overall preference for the same 100 slides shown in Phase 1. This time the low end of the scale represented no preference for the slide while the high end represented a maximum amount of preference.

Analysis

Using JAN I, a multiple regression equatio was computed for each of the 78 raters. Overal preference ratings served as values of the dependent variable while the means of the 10 dimension ratings served as values of the independent variables. Using JAN II, individua regression equations were clustered into homogeneous groupings.

RESULTS

Individual Regression Analyses

The results of the regression analyses performed upon the preference judgments of each rater (JAN I) indicated that only 17 of the 78 raters (22 pct) can be considered fairly reliab ($R^2 > 0.50$). There was also a substantial degree of variation in consistency with R^2 values ranging from a high of 0.655 (Rater 77) to a low of 0.080 (Raters 40 and 65).

The interpretation of zero-order correlations as indices of importance is not strictly appropriate in this study due to substantial correlations among some of the predictors (Dudycha and Naylor 1966, Schenk and Naylor 1968, Darlington 1968, Zedeck and Kafry 1977).

However, the vector of regression weights for each of the 10 dimensions represents each subject's policy and each of the weights may be thought of as an importance index (Taylor and Wilsted 1974). As an example, the preferenc evaluations of the first rater were most heavily influenced (largest weight) by the amount of mountains and least influenced by the amount of clouds. There was no clear pattern in terms of which dimension received the highest weight. The five dimensions most often weighted the heaviest by the subjects were: sky 17 percent, mountains 15 percent, undisturbed forest 19 percent, clouds 13 percent and man-changed area 12 percent.

JAN II Clustering

As the number of groups was systematically reduced from 78 separate equations to one overall policy (JAN II), R^2 dropped from 0.358 to 0.109. The former R^2 means that about 36 percent of the variance in landscape preference is predicted by the 10 dimensions by using 78 policies. If only one policy is used, only about 11 percent of the variation in preference is predicted.

The greatest initial increase in standard error was used as a criterion to decide how many separate group policies existed (Propst 1979). Since the greatest initial increase in error occurred in the change from 4 groups (SE = 3.102) to 3 groups (SE = 4.859), the existence of 4 meaningful clusters was assumed.

Final Models

Once clusters of "homogeneous" raters have been identified, the final two steps in the PC procedure are to derive the composite linear models for each group and attempt to determine why these groups are different.[3] The JAN software does not compute the final composite regression equations. Another statistical package or program must be employed. In this study, the stepwise regression procedure available in the SAS (Statistical Analysis System) package was used to generate the final group models. The results, as shown in table 1, indicate the existence of four separate group policies. For instance, the first group is composed of 17 members whose policy reflects heavy reliance on visible distant landforms and foreground vegetation in making overall preference judgments.

Christal (1968) contends that it is possible to have low interrater agreement among the entire sample but still be able to cluster raters into two or more groups displaying high agreement. Inspection of table 1, however, indicates that this did not occur. The multiple R^2 for the full model for all 78 subjects is 0.09, indicating that this particular linear combination of variables accounted for only 9 percent of the variance in landscape preference judgments. Clustering the raters into separate groups led to an increase in R^2 in three out of four groups, but the amount of variance explained (10 to 17 percent) is still considerably lower than the amount explained in other landscape preference research using multiple regression.

Determining Sources of Variation

The purpose of this section is one of "data-snooping" in an attempt to discover (1) why raters were inconsistent and (2) why the final models accounted for such a small percentage in variance. For future landscape research involving PC, it is necessary to try to explain why these phenomena occurred.

Rater Inconsistency

One logical means of beginning the search for sources of error is to eliminate those raters who were unreliable and recalculate the composite policy. The method for selecting reliable subjects is fairly simple: choose those subjects whose R^2 values exceed a predesignated criterion (i.e., 0.50 in this study).

Slide Variability

In addition to the possibility of unreliable subjects confounding the results of this study, there may have been something about the characteristics of the landscape slides or the manner in which they were presented that led to unaccounted for variability in the final models. For this reason, the effects of slide variability and order of presentation were investigated.

Because of possible wide variability in ratings of the slides at the beginning of the tray, the ratings on the first 20 slides were eliminated from the analysis and then rater policies were "recaptured" using only the ratings on the last 80 slides.

To investigate the effects of possible fatigue and reliabilities in different portions of the study, the slides were also split in two ways: a 50-50 split and a 33-33-34 split. For each of these splits (i.e., first 50 slides, second 50, first 33, middle 33, and last 34), rater policies were recaptured.

Recapturing Rater Policies

There was considerable variation in individual rater reliabilities within the different combinations of slides. Recall that when judging all 100 slides only 22 percent (17 out of the 78) of the subjects had reliabilities of 0.50 or above. The number and

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[3] In the original study (Propst 1979) on which this paper is based, insufficient background information for determining the reasons for group differences was collected. Thus, this part of the analysis has been omitted from the discussion in the present paper.

Table 1 -- Final multiple regression models; groups based on JAN II clustering process.[1/]

Group Categories	S	FV	Standardized beta weights[2/]					VDL	UF	C	Constant	R^2
			G	B	M	MCA	UEV					
All Subjects (n = 78)[3/]	-0.09[4/] (8)	0.14 (6)	-0.18 (5)	0.23 (1)	-0.22 (3)	0.19 (4)	-0.09 (7)	0.21 (2)	0.08[4] (9)	0.03[4] (10)	4.47	0.09
Group One (n = 17)	---	0.44 (2)	-0.31 (3)	0.28 (4)	-0.27 (5)	0.20 (6)	---	0.45 (1)	---	---	3.08	0.17
Group Two (n = 22)	---	---	-0.27 (5)	0.50 (3)	-0.38 (4)	0.53 (2)	-0.10[4] (8)	0.20 (6)	0.68 (1)	0.16 (7)	0.30	0.10
Group Three (n = 25)	-0.39 (1)	0.15 (5)	-0.25 (2)	---	---	0.15[4] (6)	-0.14 (7)	---	-0.18 (4)	-0.21 (3)	9.31	0.17
Group Four (n = 14)	0.22 (4)	-0.21 (5)	0.26 (2)	0.15[4] (6)	-0.25 (3)	---	-0.10 (7)	---	---	0.26 (1)	4.19	0.05

[1/] The numbers in parentheses represent the rank order of dimensions within each group.

[2/] S = sky; FV = foreground vegetation; G = green colors; B = blue colors; M = mountains; MCA = man-changed area; UEV = unobstructed expanse of view; VDL = visible distant landforms; UF = undisturbed forest; C = clouds.

[3/] "n" refers to the number of subjects, not the number of observations on which the regression models are based. Thus, this model is based upon 7800 (78 subjects x 100 judgments/subject) data points, the Group One model is based upon 1700 data points, etc.

[4/] $p > .05$

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percentage of reliable subjects making preference judgments on the remaining combinations of slides can be summarized as follows:

Slide Combinations	Number	Percent
Last 80	23	29
First 50	32	41
Last 50	34	44
First 33	57	73
Middle 33	50	64
Last 34	42	54

A rather obvious result is that the percentage of R^2's for all the various combinations is greater than the R^2's associated with the 100 slides. There also appears to be both a fatigue effect (high variability in ratings of slides toward the end of the 100) and an order effect (high variability in ratings of slides toward the beginning of the 100) influencing rater consistency. This hypothesis is corroborated by observing the percentage of R^2's associated with the first 33 (73 pct) and last 34 (54 pct) slides. The substantial percentage (54 pct) of reliable subjects in the "Last 34 Slides" category indicates the presence of an order effect when compared to the "All 100 Slides" category. The declining percentage of reliable subjects going from the first to the middle to the last third of slides, however, reveals the dominance of the fatigue effect over the order effect. Variations in consistencies among the other slide groupings are probably also due to fatigue or order effects (Propst 1979).

Reclustering Raters

Table 2 summarizes the results of the JAN II clustering process for the various combinations of data just described. Table 2 emphasizes the superiority of judgments made during the first third of the slides. That is, when only considering overall preference judgments made on the first 33 slides, approximately 59 percent of the variance is predicted by using 78 separate policies; about 24 percent of the variance is predicted when only one policy is used. Again, these findings show the existence of a fatigue or other type of effect on ratings made near the end of the tray of slides.

The overwhelming finding that emerges from this final analysis is that no matter how raters or slides are combined, the composite models account for only a small amount of

Table 2 -- Summary of JAN II results (change in predictive efficiency, R^2) for various combinations of slides and subjects.[1]

Combinations	Before any combining R^2	SE[2]	After combining all groups into one R^2	SE[2]
All 100 slides	0.36	0.03	0.11	7.85
Last 80 slides	0.39	0.04	0.13	9.40
First 50 slides	0.45	0.08	0.16	12.30
Last 50 slides	0.46	0.08	0.14	8.61
First 33 slides only	0.59	0.16	0.24	18.05
Middle 33 slides only	0.55	0.19	0.17	23.59
Last 34 slides only	0.50	0.09	0.13	37.09
All 100 slides, 17 subjects only[3]	0.58	0.10	0.34	1.90

[1] Unless other wise indicated, these data apply to a subject sample size of 78.

[2] Standard error of the estimate before the last two groups are combined into one (JAN II does not compute the error term for the single policy system).

[3] Subjects whose R^2 values (JAN I) were ≥ 0.50 after rating all 100 slides.

variation in landscape preference. Even when the preference ratings of the 17 most reliable subjects were used as landscape preference values, the resulting model accounted for only 26.1 percent of the variance.

DISCUSSION

Individual Variation

The regression equations generated in this investigation failed to explain more than 10 to 26 percent of the variance in landscape preference. For future users of the PC procedure, the possible reasons for these low R^2 values must be addressed. It must be emphasized that low R^2's are not necessarily indicative of a poor rational model, only a poor empirical one.

This study was concerned with how individual raters assessed information about 10 dimensions in order to form an overall evaluation of landscape preference. The results of the rater analyses are consistent with those of other judgment studies utilizing the PC approach (see Zedeck and Kafry 1977). In this study the R^2's ranged from 0.36 to 0.59 when separate policies were used. In many instances the reliabilities for individual policy equations were fairly high (0.50 to 0.80). Thus, the linear regression equation can explain rater policies.

The cues that a rater uses in making a judgment are obviously not equally important and raters do not rate them equally. The purpose of using a linear model is to make the judge's policy explicit. Considerable individual variation was an obvious result of this study: there was no discernable pattern as to which dimensions were given the highest weights. This degree of individual variation seems to run counter to previous landscape preference studies. Impressive agreement has been observed among individuals in a variety of subgroups from professional designers to high school students and housewives (Shafer et al. 1969, Wenger and Videbeck 1969, Coughlin and Goldstein 1970, Zube et. al. 1974, Buhyoff and Leuschner 1978, Buhyoff and Wellman 1979). However, the degree of individual variation found in this study suggests that the careless adoption of one multiple regression model to represent all raters is bound to lead to contradictions among individual preferences. The PC procedure identifies individual differences and thereby provides a starting point for resolution of these conflicts.

Rival Hypotheses and Methodological Problems

Possible reasons for the failure of the final model to capture more of the predictable variance in preference can be summarised as follows:

1. raters were using cues in a nonlinear fashion.
2. the wrong independent variables were used.
3. slides are not valid representations of actual landscapes.

4. cue intercorrelations deflated R^2 values obtained.
5. simple rating scales are subject to too many biases.

These issues are discussed in more detail elsewhere (Propst 1979). Briefly, visual inspection of data plots and the entering in of all interactive ($X_1 \cdot X_2$, etc.) and power ($X_1{}^2$, etc.) terms into the final model revealed an inconsequential effect of nonlinearity. Nonetheless, future studies of landscape preference should consider possible nonlinear influences.

Second, there is empirical evidence for the independent variables chosen (Peterson and Neumann 1969, Craik 1972, Carls 1974, Zube et al. 1974, Brush and Shafer 1975, Harvey 1977). Thus, failure to employ proper predictors is not considered to be a serious rival hypothesis.

Third, numerous studies provide evidence that people evaluate representations of landscapes in the same manner in which they evaluate actual scenes (Coughlin and Goldstein 1970, Shafer and Richards 1974, Zube et al. 1974, Daniel and Boster 1976, Jackson et al. 1978).

Fourth, the intercorrelations of some of landscape dimensions do not explain why the models failed to account for more variance than they did. Two studies (Dudycha and Naylor 1966, Schenk and Naylor 1968) indicate that the use of an R matrix with high correlations may actually inflate the amount of variance explained. The real problem with high cue intercorrelations is not a reduction in R^2 but the inability to interpret zero-order validity coefficients as indices of importance.

This leaves only one other plausible rival hypothesis: the use of rating scales to measure dimensions and preference. Rating scales are notoriously prone to such errors as the halo effect and errors of central tendency. They are also easily faked. In addition, the difficulty of defining some dimensions, such as unobstructed expanse of view, visible distant landforms, and undisturbed forest, is evidenced by the relatively high standard deviations associated with these cues for many of the slides. Such rater inconsistency calls for a more objective measure of landscape dimensions, perhaps a grid analysis similar to that used by Shafer and his colleagues (1969).

To summarize, numerous plausible rival hypotheses have either been ruled out or discounted. It appears that the method in which landscape preference and dimension values were obtained is the single largest source of error and, hence, the reason why individual and composite models did not capture more of the variance in preference than they did. The need for future research employing different scale anchors (e.g., scenic beauty instead of preference), a different method of measuring the dimensions (e.g., grid analysis), and a different method of measuring preference (e.g., psychophysical scaling) is evident.

SUMMARY AND CONCLUSIONS

The first objective of this study appears to have been well-satisfied. Policy capturing is a conceptually and empirically sound method for investigating individual and group differences in policies concerning landscape assessment. The admonition for landscape preference research is clear. The extent of individual differences must somehow be assessed for, if people show much variation in their judgments, decisionmakers must know that any action based on an average index may represent the perceptions of only a minority (Craik and Zube 1976 The broad range of weighting strategies employed by raters in this study is viewed as evidence of the potential for significant individual variations in landscape preference which somehow needs to be accounted for in future studies of this kind.

The second objective of this study, identification and weighting of the most important landscape dimensions, appears to have been only minimally satisfied. The consistently low R^2 values indicate that scenes rated by the same judge tended to be rated on different criteria. This phenomenon is thought to be a result of having subjects make judgments using simple rating scales.

Besides being a useful procedure for evaluating individual and group differences in preference, PC can serve as an aid to the landscape decisionmaker as well. Knowledge of variations in weighting strategies among individuals in various user groups (e.g., recreationists, environmentalists, mining interests) can help the manager or planner decide what effects certain landscape manipulations (e.g., locations of transportation and utility corridors, location of visitor service facilities) will have on public acceptance.

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A Computerized System for Portrayal of Landscape Alterations[1]

A.E. Stevenson, J.A. Conley & J.B. Carey[2]

Abstract: The growing public awareness of and participation in the visual resource decision process has stimulated interest to find improved means of accurately and realistically displaying proposed alterations. The traditional artist renderings often lack the accuracy and objectivity needed for critical decisions. One approach, using computer graphics, led to the MOSAIC system which is a special adaptation of photomontage techniques capable of meeting most of the requirements for realism, accuracy and cost.

This paper briefly covers some of the early development and explains some of the more innovative concepts of the system. The development and demonstration phases were conducted using actual landscape alteration problems. Key steps involved in field measurement, photography, computer input and output, artist enhancement, documentation and training materials are described.

Finally, capabilities and limitations are discussed in terms of the applications of the system. Specific issues will include costs, data requirements, ranges and scales, terrain characteristics and skill needs.

MOSAIC

Introduction

MOSAIC is a low cost computergraphic system for producing accurate portrayals of proposed landscape alterations -- with realism. The system was developed expressly for the typical problems encountered by landscape architects and land use planners. It has been demonstrated, installed, and checked out on the USDA computer located in Ft. Collins, Colorado. User and programmer documentation has been prepared. A training course has been documented and applied to develop a National Training Team.

This paper describes the development of the MOSAIC system which was a joint effort of specialists in The Aerospace Corporation and the Forest Service. The use and capabilities of the system are briefly discussed. Finally, it describes solutions to some problems encountered while achieving the functioning system.

Early Work

When initial work was begun in 1970, we believed the concept of using computergraphics to draw the landscape and proposed alterations was a novel idea. Later we would discover that others were also exploring the same area. We were aware of the existence of software which could draw perspective views of terrain using digitized contour elevation data. In fact, we were using just such a program to test the quality of terrain data processed for a Forest Fire Model being developed for the Forest Service. It occurred to us that such a system might also be used to portray landscape alterations. We contacted Dr. Gary Elsner of the Forest Service and he confirmed that if such a model could be developed, it might become a useful tool for landscape architects. We were to learn that developing such a computer system was somewhat more complex than we first envisioned. We did appreciate that our early efforts might have a high probability of nonapplicability or even failure and, therefore, elected to do a substantial

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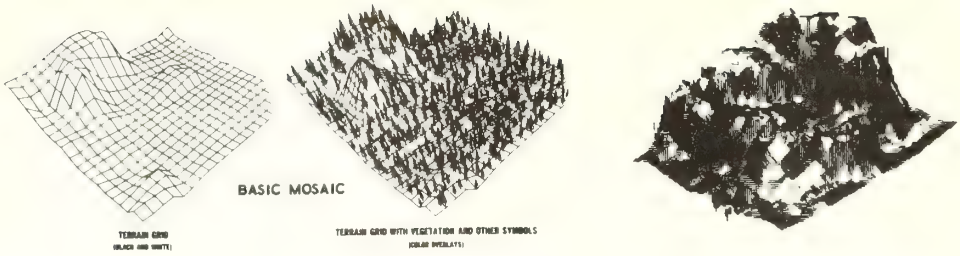


Figure 1--Light intensity algorithms for the front face of the Santa Barbara Mountains.

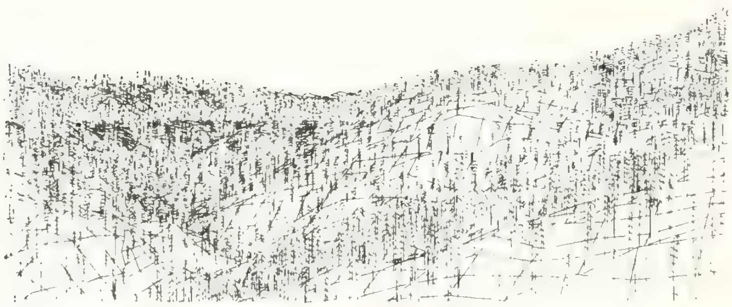


Figure 2--Southeast view of Pansy Creek area proposed timber cuts--black and white pen plot.

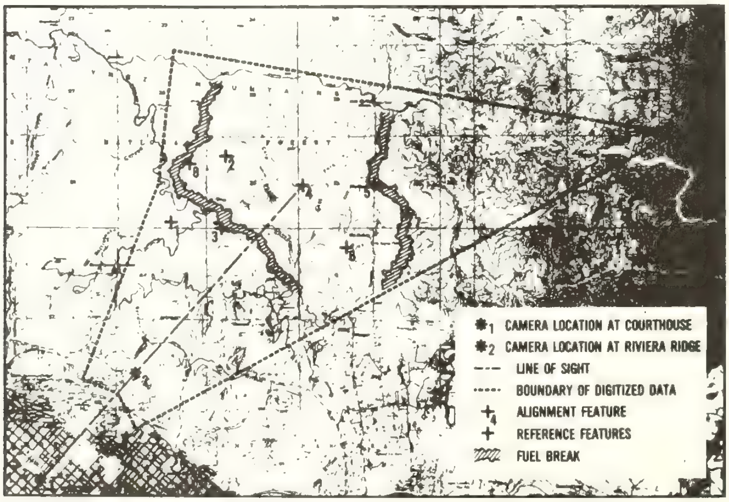

✱1 CAMERA LOCATION AT COURTHOUSE
✱2 CAMERA LOCATION AT RIVIERA RIDGE
--- LINE OF SIGHT
----- BOUNDARY OF DIGITIZED DATA
+4 ALIGNMENT FEATURE
+ REFERENCE FEATURES
▨ FUEL BREAK

Figure 3--Map used in MOSAIC photomontage of Santa Ynez fuel breaks.

portion of the initial development with corporate funds. As the system began to achieve the demonstrated capabilities, the Forest Service provided increased funding to the program.

The corporate funds were being used to support experimental research of computergraphic techniques. The Forest Service funds were directed toward a literature search of the current state of the art in computergraphics equipment and software. It was felt that the findings of this research could have direct application in producing displays of proposed landscape alterations. The results of the search by A. E. Stevenson, et al. (1973) provided a broad foundation upon which to build the final system. A greater appreciation for the limitations and costs of existing systems was also achieved.

The early experimental work at Aerospace consisted of finding an efficient computer program to convert terrain data into plot data. This program contained a hidden-line removal subroutine which eliminates those portions of both terrain and landscape alterations that would naturally be hidden by the foreground. As time progressed, symbols for trees and other objects were added to the basic graphic capability. Experiments were made to incorporate color and shadows. Light intensity algorithms were developed and a series of drawings were produced (Fig. 1) for the front face of the Santa Barbara mountains and a demonstration area at Pansy Creek in Oregon. In spite of great effort and many innovative techniques, it eventually became apparent (Fig. 2) that this capability would not yield the required realism within practical cost boundaries.

The Photomontage Concept

The inability of these early computergraphic techniques to achieve the needed realism was truly discouraging; however, it was decided to again review the techniques uncovered in our original survey of computergraphic art. One method that was particularly appealing was the photomontage concept. It had the potential of combining the realism of photography with the accuracy of the computer-generated graphics and artist enhancement. The literature revealed, however, a serious difficulty in aligning the computergraphic origin with the camera origin and view orientation. The experimenters in the literature had used theodolites to achieve camera alignment and ground survey data to determine position. The photographs were made on glass plates with measurements made by manually operated, optically accurate comparators. The equipment and techniques were far too complicated, time consuming and expensive for the field applications we envisioned. A method for achieving the needed registration was developed by Aerospace and is described in a paper by J. Carey et al. (1975).

The method devised to locate the camera origin and determine its orientation was one of selecting a number of reference features (four or more) which could be readily recognized and accurately measured on both the photograph and on the area map. The reference points or alteration location are limited to distances of ¼ to ½ mile or greater from the camera origin. These requirements place some restrictions upon the type of terrain where MOSAIC can be easily applied.

With the measurements of the reference points as input, a computer software program (Carey, et al. 1976) is then able to solve for the most likely camera position and orientation (fig. 3). Initial estimates of camera location are input; however, these can be rough guesses, with errors of several thousand feet in position and angle errors are great as 10 degrees. These inputs merely provide a starting point for the computer program.

Now that the camera position and orientation angles have become known, the computer is now able to portray the landscape alteration when required inputs are supplied. On unfamiliar terrain we have found it useful to draw the terrain itself and overlay it on the photograph for an initial terrain registration check (fig. 4). This step will reveal errors in the digitized data as well as errors in camera position and orientation angles. While this step is not essential, we have found its inclusion avoids many problems further downstream.

The computer now contains the origin and field of view which gives the best match of graphic overlay with the photographed terrain. It also contains a data set for the digitized terrain which is without major errors. The remaining step is to define and input the proposed landscape alteration to be displayed. There is a substantial library (Fig. 5,6) of graphic options within the computer software. We will examine these as classes and show some example of each.

The first class of alterations are those which change the shape of the terrain. These include surface mine pits and spoil banks, dams and lakes, and roadbeds for highways and railroads. There are some special subroutines within MOSAIC which assist in preparing input changes to the terrain data, i.e., the computer input for surface mines is able to use the pit dimensions to also define the spoil bank configuration. It does, however, require some additional input data, i.e., the angle of repose, and the expansion of the overburden. The roadbed input is based on cross section dimensions and center line locations. Dams are similar to roadbeds and lakes are a large fill with a single elevation dimension.

The second class of graphics are those which are superimposed on the surface of the terrain. These include revegetated areas, fuel breaks, timber cuts, ski runs, trails and boundaries. The inputs

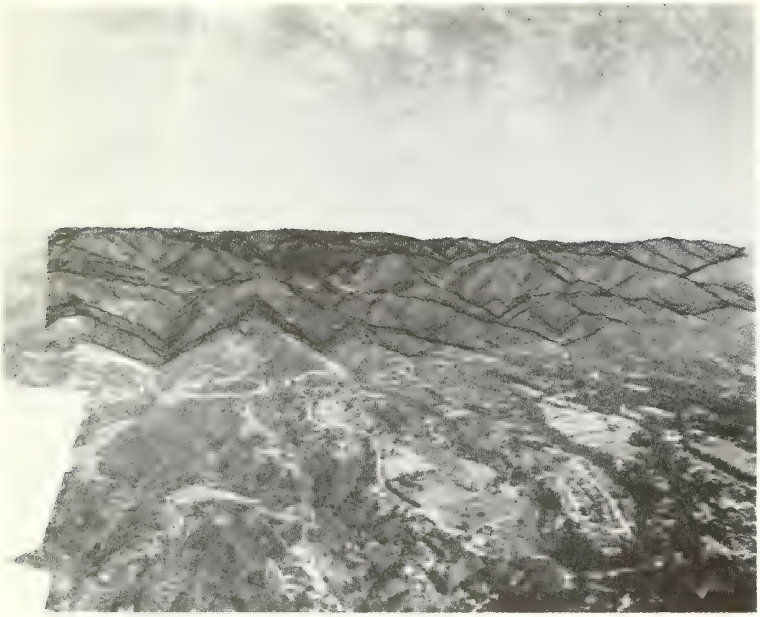
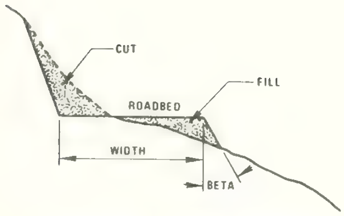


Figure 4--Terrain registration.



Cross Section of Roadbed with Cut and Fill

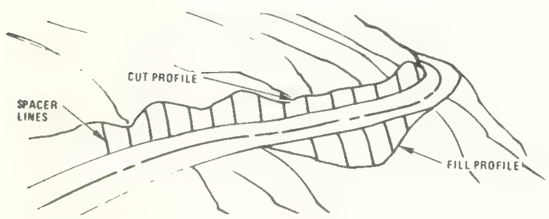


Figure 6--Prospective view of roadbed.

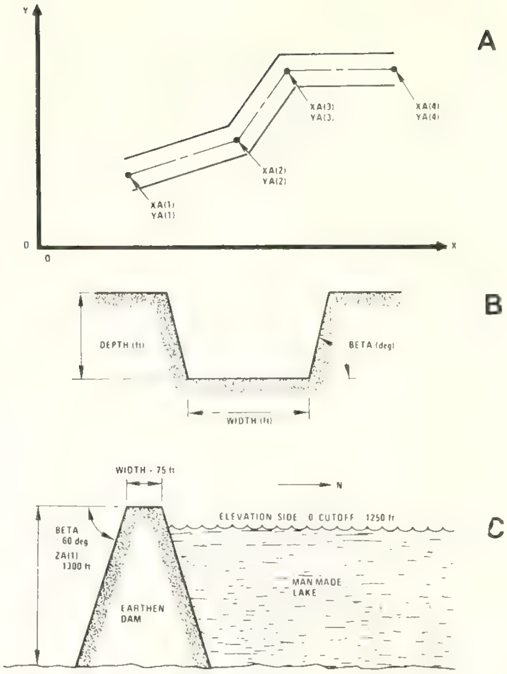


Figure 5--(a) Plan view of surface mine, (b) cross section view of surface mine looking from point 1 to point 2, (c) cross section of earthen dam and man-made lake.

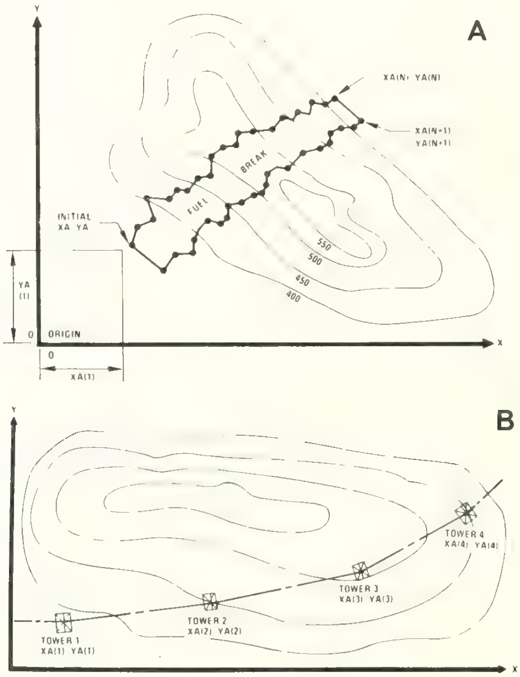


Figure 7--(a) Fuel break superimposed on contour map, (b) plan view of power line system.

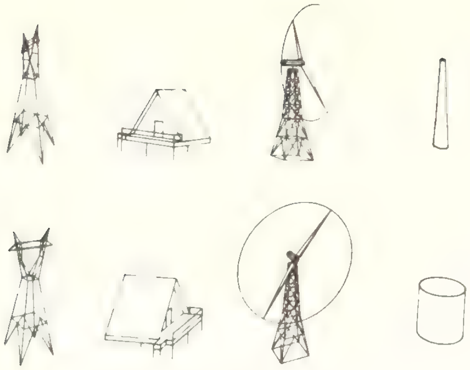


Figure 8--Structures.

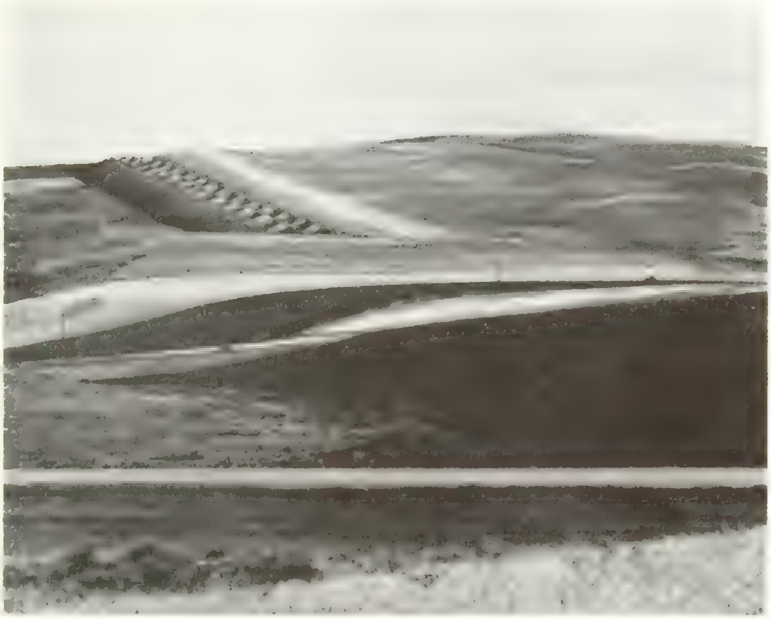


Figure 9--MOSAIC portrayal of surface mines.

Figure 10--Original mountainous terrain.

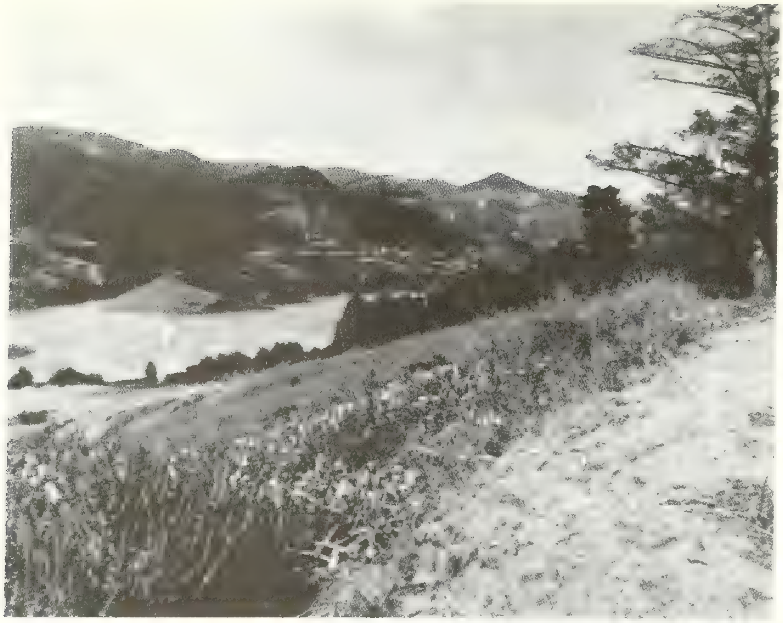


Figure 11--Terrain with lake superimposed by MOSAIC methods.

here consist of an ordered set of map measurements (x,y) which define the outline of the alteration (Fig. 7).

The third class of graphics are structures which may be found in the wildland area. There are subroutines for A-frame cabins, tanks, smokestacks, powerline towers and large power windmills (Fig. 8). When proper position measurements, desired structure sizes and azimuthal orientation parameters are supplied as input to the computer program, the system will locate, draw the structures to scale, and provide the appropriate terrain concealment.

When these measurements are properly input, the system will produce a tape which can be used to drive a plotter. The graphics, produced on mylar by this plotter are then used as an overlay to assist the artist to produce an enhanced rendering. Based on our experience, we feel that this combination of computergraphics and artist enhancement produces the maximum realism at the minimum cost.

Let us briefly examine some examples of the computer output.

An example of the artist enhancement is shown on Figure 9 for a demonstration project of surface mines planned for Craig, Colorado. The computer outlines were colored by the artist to provide realism.

Another example is a view of a proposed lake in mountainous country. Figure 10 shows the original terrain and Figure 11 shows the terrain with the lake superimposed.

The brevity of this paper prevents the detailed explanation of the mechanics of applying the system or its internal workings; however, these are covered in the programmer's handbook and user manuals (Carey et al. 1976, 1979).

The project represents a total program which includes landscape architecture research, engineering and computer techniques. It also represents an example of cooperation between a governmental agency and a nonprofit corporation in a creative research program.

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Analysis of Landscape Character for Visual Resource Management[1]

Paul F. Anderson[2]

Abstract: Description, classification and delineation of visual landscape character are initial steps in developing visual resource management plans. Landscape characteristics identified as key factors in visual landscape analysis include land cover/land use and landform. Landscape types, which are combinations of landform and surface features, were delineated for management purposes by analyzing land resource data for a study area near Ames, Iowa. Then quality ratings and land use controls were developed for each landscape type in the study area. This approach is currently being used in several resource planning and management programs in Iowa.

INTRODUCTION

Landscape planning is one of several inputs in the comprehensive planning process, along with social planning and economic planning. In all three types of planning, the need exists for input from visual landscape analysis. Visual landscape analysis has three major stages (Unwin 1975):

1. Inventory, description, and classification of landscapes--the landscape measurement stage.
2. Investigation and measurement of value judgments or preferences for the visual landscape--the landscape preference stage.
3. Assessment of the quality of the objective visual landscape in terms of individual or societal preferences for individual landscape types--the landscape evaluation stage.

Collectively, these three stages comprise visual landscape analysis (sometimes called landscape assessment or landscape evaluation) which, when combined with other types of landscape analysis, can provide useful information for use in landscape planning, design, engineering, and management.[3] One specific need in visual landscape analysis is for methods and techniques to describe, classify, and delineate landscape character efficiently and accurately in the first stage prior to applying value judgments or preferences.

Application to Iowa

The Landscape Architecture Department and the Land Use Analysis Laboratory at Iowa State University have been active since 1971 in an analysis of the state's visual landscape character and in developing tools and techniques for landscape planning in general. Before beginning a technical analysis of detailed land information sources, the Laboratory examined general data sources. These general data were analyzed in terms of how visual patterns were created on the landscape. The result was a delineation of ten landscape regions of Iowa and descriptions of typical topography, drainage, soil, vegetation, urban and land management patterns (Faxlanger, Sinatra and Uban 1973).

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[1] Presented at the Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Landscape Architect and Resource Analyst, Land Use Analysis Laboratory, Iowa State University; and Instructor, Department of Landscape Architecture, College of Design, Iowa State University, Ames.

[3] Concepts, techniques, principles and applications of landscape analysis are described in a forthcoming book, Regional Landscape Analysis, by Paul F. Anderson.

The Land Use Analysis Laboratory is an interdisciplinary research team with active input from socioeconomic, engineering, physical science, resource management, environmental design and planning disciplines. A major thrust of the Laboratory has been the development of computer-assisted landscape analysis techniques and software. The Multi-Scale Data Analysis and Mapping Program (MSDAMP) is a computer program for the static modeling and display of data on spatially-distributed land characteristics. The systems package is based on data overlay concepts, statistical sampling of data, multiple resolution analysis and geodetic coordinates (Beavers 1977).

During the past two years, analysis techniques have been developed expressly for visual resource management considerations in the landscape planning process using existing MSDAMP program capabilities and existing data at the Land Use Analysis Laboratory. Techniques for classifying and analyzing visual landscape resources were needed to add to those already developed at the Laboratory for soil, vegetation, wildlife, water and mineral resources. Techniques were needed that also were appropriate to landscapes of the central interior plains. The work has been supported by the Design Research Institute of the Iowa State University College of Design, in cooperation with the Land Use Analysis Laboratory, the Iowa Agriculture and Home Economics Experiment Station, Story County and the City of Ottumwa, Iowa.

The research work on visual landscape analysis at Iowa State University began with an investigation of landscape characteristics which are used to describe and classify landscape character. Using data on these landscape characteristics, landscape types were described, classified and delineated in a local study area (fig. 1). This approach is currently being used for several resource planning and management studies in Iowa.

LANDSCAPE CHARACTERISTICS

Landscape analysis models may be descriptive or predictive. Descriptive models are useful for landscape measurement, the first stage of visual landscape analysis. This paper reports the work to date in Iowa on descriptive models involving independent variables (landscape characteristics). Predictive models are useful for landscape preference, the second stage of visual landscape analysis. Work on predictive models for Iowa landscapes is reported in Nassauer (1978). Finally, these two types of models are currently being combined in specific applications for visual resource management: scenic quality ratings, plan and policy formulation and plan evaluation.

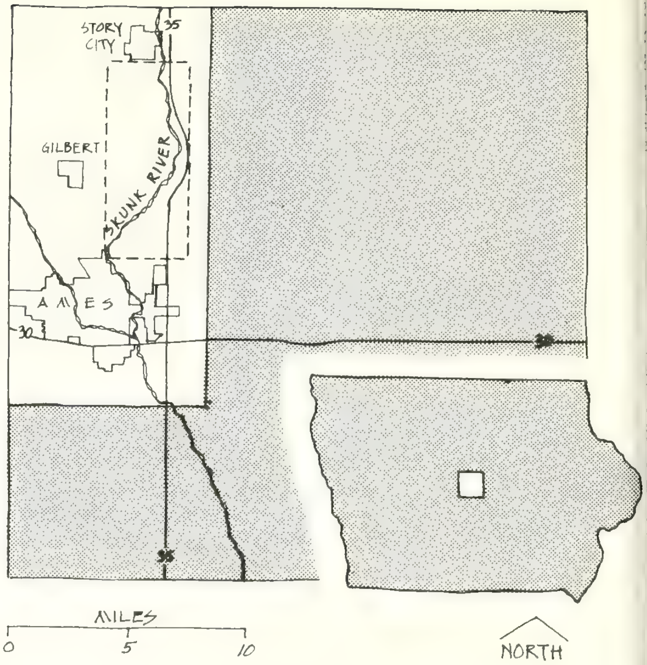

Figure 1--Location and features of the Skunk River valley study area in Story County, Iowa mapped in figure 2. Broken lines indicate the recreation greenbelt area mapped in figure 3.

A review of investigators' literature suggests that two landscape characteristics--landform and land cover/land use--are indicators of visual landscape character.[4] These two landscape characteristics describe the shape of the land surface, natural and man-made materials on the land surface, and cultural activities on the land surface. Many land use and natural resource planning and management studies typically involve data on landforms and land cover/land use. In Iowa studies conducted by the Land Use Analysis

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[4] A more complete description of results is contained in the forthcoming final research report to the Design Research Institute, College of Design, Iowa State University, Ames.

Laboratory, landform characteristics are derived by interpreting soil survey data. Land cover and land use characteristics are derived by interpreting aerial imagery, topographic maps, geology maps and maps of surface water.

LANDSCAPE TYPES

Description

Landscape types are areas of homogeneous visual landscape character, which may be described by the basic visual elements of various landform types and land cover types. Form, line, color and texture are the basic visual elements often listed as determining the visual response to landscape characteristics (Stone 1978). Thus, a descriptive model for the first stage of visual landscape analysis has this general form: landscape character is a function of the form, line, color and texture of landform and the form, line, color and texture of land cover/land use.

To avoid unnecessary introduction of value judgments in the first stage of visual landscape analysis, landscape types must be based on value-free measures of landscape character (Jacobs 1975). An approach used in this study is to assume that landscape types are described by unique combinations of landform types and land cover types.

Classification

The next step in completing a delineation of landscape types is classification of landforms into various classes. A classification of land cover is likewise needed. Landform classes and land cover classes must be selected based on visual characteristics so that they are reasonably representative of their actual state. First, how can landforms be classified based on form, line, color and texture? The shape of the land surface is one answer--ridges are convex, depressions and drainageways are concave. Orientation of the ground plane is another possibility--horizontal, vertical, or sloping. Degree of topographic enclosure may also be useful as in relative position of the observer with the landscape--superior, normal, inferior. Information for all three of these is provided by interpreting soil data for landscape position. Landscape position indicates general landform shape, slope, topographic enclosure and relative landform position.

Second, how can land cover/land use be classified based on form, line, color and texture? Materials covering the land surface have different visual characteristics--man-made, plants, water, minerals. Differences in the intensity of human use and management of these surface materials also have visual expressions. An example of this in Iowa is the visual differences between tree plantations with regular tree spacing and woodland areas with random tree spacing. A third basis for land cover/land use classification for visual analysis is the height of land surface materials which, along with landform, affects spatial enclosure and view distances. Surface material, height and intensity of human use and management together become a meaningful basis for land cover/land use classification.

Delineation

Each unique combination of landform and land cover/land use as previously classified is considered a landscape type. A specific model of landscape types was prepared for the study area using appropriate data on landform classes and land cover/land use classes (fig. 2). This delineation of landscape types was verified and documented through field evaluation and photography.

APPLICATIONS

The second stage of visual landscape analysis, the preference stage, includes the identification and measurement of value judgments or preferences for the visual landscape. Nassauer (1978) established a predictive model for visual value in Iowa by asking 150 respondents in a sample population to rate the visual quality of 82 selected photographs of Iowa's landscapes. Land use, water presence and topography were, in declining order, the most significant physical characteristics of the scenes in predicting visual value, according to the study. Together, these three characteristics explained 67 percent of the variance in the respondents' visual value scores.

This work and the descriptive model of landscape types in Iowa become the basis for the third stage of visual landscape analysis, landscape evaluation. In this stage, documented values are applied to landscape types to assist in making visual quality ratings in a study area, establishing land use policies, formulating land use and management plans and evaluating proposed plans or actions.

Scenic Quality Ratings

One of the first steps in developing or evaluating landscape policies and plans is the measurement of scenic quality in the policy or plan area. Scenic quality may be estimated in

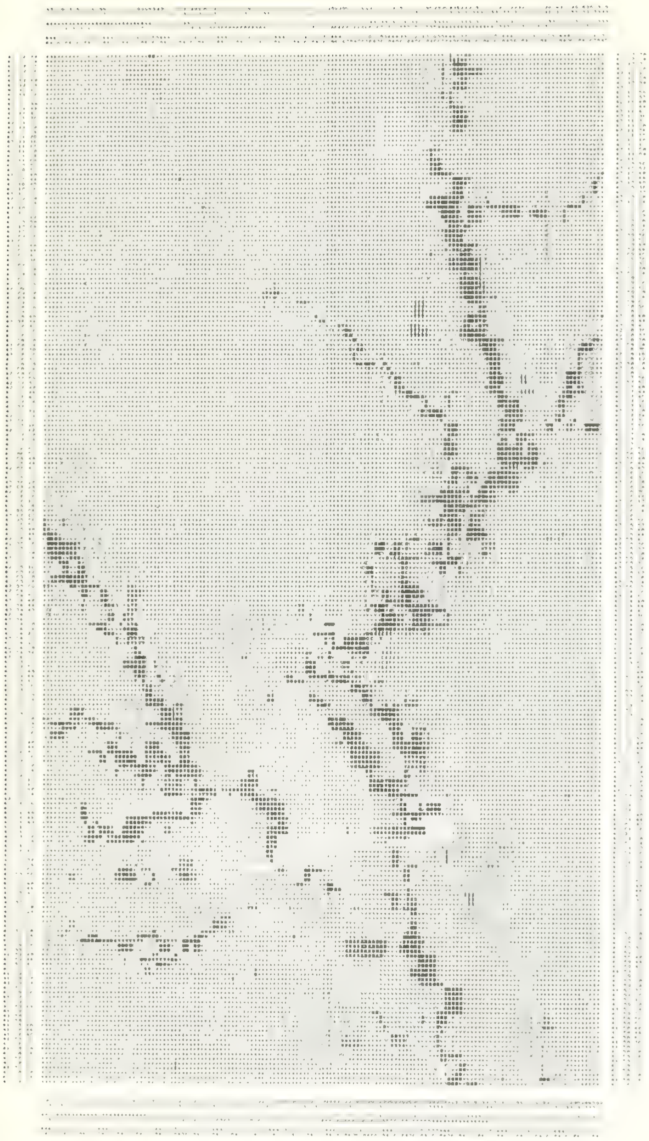

Figure 2--Landscape types. Darker symbols represent areas of lower intensity human use and management. Each of the 31,682 symbols represents 2.78 acres.

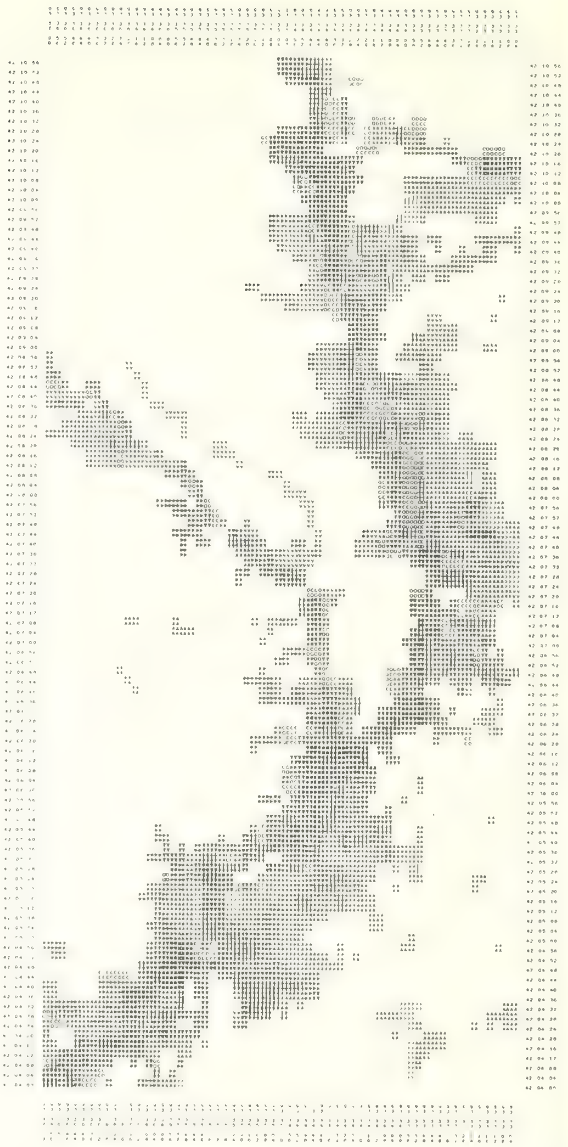

Figure 3--Scenic quality rating of the Skunk River recreation greenbelt. Darker symbols represent areas with higher ratings.

a study area by applying visual landscape preferences to landscape types. The framework for estimating scenic quality ratings was established by combining landscape preferences in Iowa (Nassauer 1978) with an adaptation of scenic quality rating criteria for western landscapes (U.S. Bureau of Land Management 1978). Major differences in the landscapes of the western states and central interior plains required careful evaluation and adaptation of BLM rating criteria. These differences included degree of cultural modifications, land ownership, road density, visual sensitivity, topographic relief, distance zones and delineation of rating units. The resulting scenic quality criteria for analyses of Iowa landscapes include--

Landform - relief and features
Vegetation - diversity
Water - presence and visual dominance
Color - land cover diversity
Adjacent scenery - compatibility
Scarcity - land cover uniqueness
Cultural modifications - degree

These criteria were tested and evaluated, first on the study area as a whole, then on broad scenic quality rating units within the study area. The rating units were delineated by aggregating landscape types in figure 2 into urban and non-urban types, then subdividing the non-urban types into upland and valley landscape positions. The mean scenic quality rating score for the entire study area was 10.2 on a scale of 1 to 33 (where 33 indicates the highest scenic quality). The mean, maximum and minimum scores for each of the rating units are--

	Mean	Maximum	Minimum
Study area	10.2	24.0	3.5
Urban	9.3	18.5	4.0
Rural upland	9.6	21.0	3.5
Rural valleys	12.0	24.0	6.0

Little significant difference is found in the results for the upland rating unit and the urban rating unit. The scores for the valley rating unit, however, are significantly higher. The test results presented here are considered an initial approximation of scenic quality ratings. Work currently in progress involves further refinement of the rating criteria and their measures for project situations and the landscape of Iowa.

Policy and Plan Formulation

Of particular concern in Iowa are areas that have high potential for recreation activities. Because over 90 percent of the state is in agricultural uses, little land is available for camping, picnicking, hiking, swimming and boating. Several counties have recognized the need to protect areas for active and water-based recreation. One approach to protection is the recreation greenbelt concept which has been included in the zoning ordinance of Story County, Iowa. Analyses of scenic quality are being used to develop a master plan for a recreation greenbelt along the Skunk River in Story County. Preliminary measurement of scenic quality in the greenbelt indicates a mean scenic quality rating of 13.1 (fig. 3).

At the state level, recent legislation provided for the establishment of state-designated Protected Water Areas in Iowa. Visual landscape analysis techniques described in this paper are being used to help develop a statewide master plan for potential Protected Water Areas. Over 3,100 miles of streams, lakeshore and wetland perimeter have been mapped using Land Use Analysis Laboratory land resource data (figure 4). These areas

Figure 4--Potential Protected Water Areas in Iowa. Darker symbols represent areas of higher potential. Each of the 229,745 cells represents approximately 156.7 acres.

are being evaluated further using aerial photography. Selected areas of high potential will then be evaluated by the Iowa Conservation Commission through site visits and meetings with local officials, landowners and interest groups. In the Protected Water Areas program, visual character is the most important consideration in selecting areas of high potential for further study and inclusion in the program.

Landscape planners working on the master plans are finding these kinds of visual analyses helpful in two ways. First, the analyses assist in locating and evaluating areas of high recreation potential. Evaluation at the general level using mapped land resource data before site level evaluation reduces the time and cost necessary to locate specific areas or boundaries. Second, the analyses help document the planners' visual perceptions and help justify their planning decisions and recommendations. This has been important in both of these studies. State legislation requires that areas nominated as Protected Water Areas be explicitly evaluated and fully documented. In Story County, an upcoming court test of the greenbelt ordinance will rely on analyses of visual resources to help document the location of greenbelt zone boundaries.

Plan evaluation

Another concern of Iowans is environmental impacts, including visual impacts, of specific plans and projects that have been proposed by public agencies and private interests. In Story County, for example, a federally-planned reservoir was proposed for the Skunk River between Ames and Story City (figure 5). Purported benefits of the proposed reservoir included flood control, water supply, low-flow augmentation, increased wildlife habitat and new recreation opportunities. Public concern for environmental impacts, including visual impacts, led to a two-year study (Dougal et al. 1973) as the basis for an Environmental Impact Statement. Reservoir construction had been deferred because of public reaction to the EIS; however, several years of dry weather have caused renewed interest in the reservoir. Several visual landscape analysis techniques described in this paper are currently being used to evaluate the visual impacts of reservoir construction and management on the Skunk River valley.

CONCLUSIONS

The visual landscape analysis techniques applied by the Iowa State University Land Use Analysis Laboratory do not replace value judgments nor do they reduce the number of planning

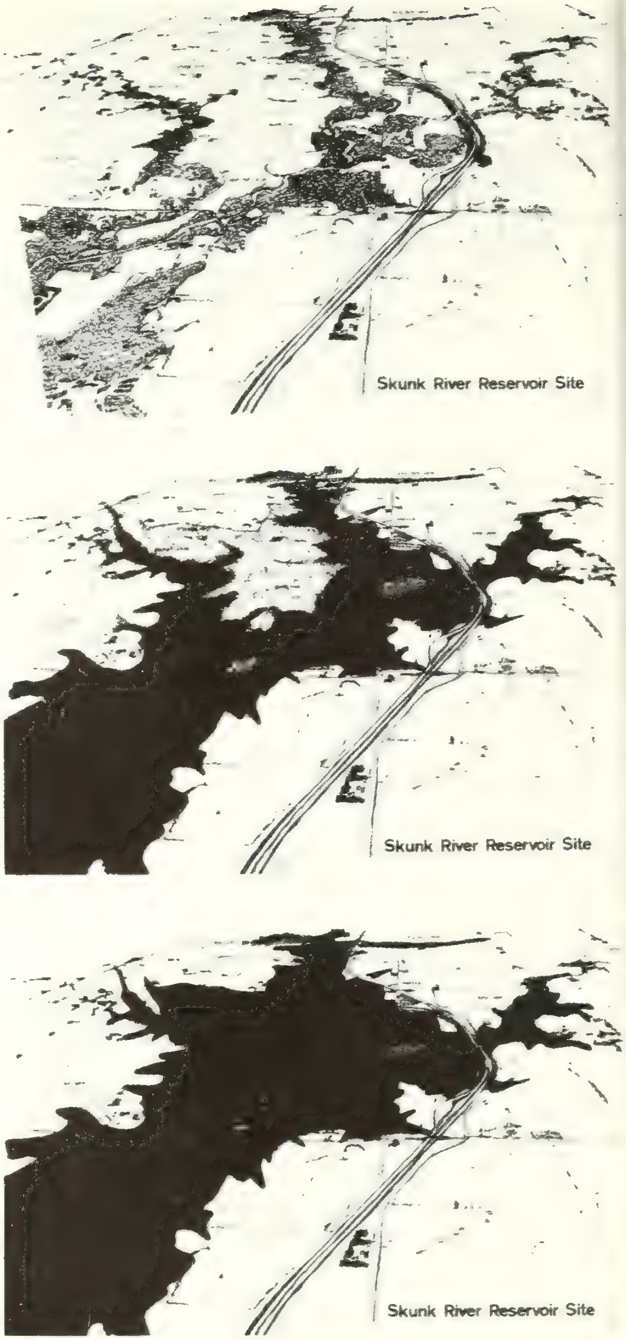
Skunk River Reservoir Site
Skunk River Reservoir Site
Skunk River Reservoir Site

Figure 5--Sketches of the Skunk River valley as it appeared in 1972 (top), with the conservation pool of the proposed reservoir (middle) and with the flood pool of the proposed reservoir (bottom).

and management decisions. Rather, the analyses assist in the systematic consideration of visual resources, in objective measurement and delineation of landscape character, and in previsualization and documentation of resource planning and management decisions. These analyses make use of data typically available in land use and natural resource studies in Iowa and make use of existing MSDAMP computer program capabilities. Additional refinement of data, program capabilities and analysis techniques will be necessary before a comprehensive program for planning and managing visual resources can be adopted in Iowa.

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Visual Absorption Capability[1]

Lee Anderson[2a]

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Geoffrey Chandler[2c]

Abstract: Visual absorption capability (VAC) is a tool to assess a landscape's susceptibility to visual change caused by man's activities. This paper explores different descriptive approaches to VAC and addresses in depth the development of the VAC process used on the Klamath National Forest. Four biophysical factors were selected to assess VAC for the lands within the Klamath National Forest. These factors are slope, vegetative pattern and screening, site recoverability, and soil color contrast with the surrounding landscape. By combining this VAC analysis with Forest Service visual quality objectives, it has been possible to develop suitability assessments for Forest Service activities which impact the visual resource.

INTRODUCTION

"The progress of true civilization is best shown by the increasing thought which each generation takes for the good of those who are to come after.

"You can ruin its forests, you can dry up its streams, you can hack and scar its surface until its marvelous beauty is gone.

"The preservation of the forest resources . . . is of vital importance to the common wealth. I go farther. No state can be judged to be really civilized which in the treatment of its natural resources does not take account of, or aim to, preserve the beauty of the land in which its people live. An aesthetic as well as economic factor is involved in the problem of conservation.

"Poor, indeed, is the conservation which does not also conserve beauty."

Theodore Roosevelt

Scenery is the most universally enjoyed natural resource in the United States today. Driving for scenic pleasure is our most popular recreational activity. Scenery contributes to our spiritual, emotional and physical well being. However, consumptive demands of society threaten the balance between conservation of scenic values and the efficient use of our natural resources. This dilemma emphasizes the need for resource utilization which considers the sensitive treatment of our visual resources. As environmental designers, our challenge is to facilitate development which is in harmony with the visual resource visual absorption capability (VAC) is a tool which helps us achieve this objective. Visual absorption capability may be considered as an element of the site analysis process which environmental designers have used for centuries. One objective of site analyses has been to harmonize man's activities with the natural elements. VAC is a way to apply this consideration to activities which impact the visual resource.

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[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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[2c] Landscape Architect, Lassen National Forest, Susanville, California.

VAC is an analytical process which identifies the landscape's susceptibility to visual change. It is a measure of the land's ability to absorb alteration yet retain its visual integrity.

BACKGROUND

During the last decade, scenery has become a recognized resource of the National Forests of the United States. The public continues to demand amenity values in the National Forests, as well as a supply of products such as timber and range. These demands for visual resource management led to the establishment of the Forest Service Visual Management System in 1974. The Visual Management System establishes methods for inventorying and mapping variety classes and sensitivity levels and determining visual quality objectives. Visual quality objectives (VQO's) express the relative importance of visual resources in the National Forests based on the land's intrinsic scenic quality (variety classes) and its sensitivity to public viewing pressures (sensitivity levels). The development of visual quality objectives is just the first step in visual resource management of National Forest lands. The land manager must also know how difficult or easy it may be to achieve those visual quality objectives on one unit of land compared to another.

Visual absorption capability establishes such a methodology. It provides the basis from which an interdisciplinary team of field experts can determine the relative costs of meeting a particular visual quality objective. Visual absorption capability assists Forest Service landscape architects in determining where to locate such things as roads, utility lines, structures, fuel breaks, and rock quarries with the least visual impact. It also helps determine priorities for specialist involvement in project planning by identifying areas which are most visually vulnerable.

Some other uses of visual absorption capability are to develop visual resource management guidelines, to supplement site analyses and provide data for the development of various design and planning solutions, and to assess a landscape's potential for scenic degradation.

The VAC concept has predictive and prescriptive applications. For predictive purposes, VAC will forecast the visual impact on the landscape for a particular activity. Generally, a landscape with high absorption capability will accept alteration with less visual impact. For prescriptive purposes, VAC identifies a landscape's visual suitability for various development activities.

Visual absorption capability also serves as a leveling influence. Many people incorrectly assume that visual quality objectives of "retention" and "partial retention" are always extremely difficult or costly to attain. A high visual absorption capability rating in such areas would suggest the opposite and thus obviate restrictions which might otherwise be imposed. On the other hand, a low visual absorption capability rating would suggest management caution even in areas of lenient visual quality objectives, such as "modification" and "maximum modification." For these reasons, VAC was added to the Visual Management System in 1977.

VAC has been discussed and used for over 10 years. It has only been in the last couple of years that the concept has gained a solid foothold as a tool for landscape assessment and management in our National Forests. Several analytical approaches have been applied on various National Forests. This paper will discuss some of the different descriptive approaches as well as the approach used on the Klamath National Forest, headquartered in Yreka, California.

VAC FACTORS

In our literature review, 3 major groupings of VAC factors have been identified. Different terminology has been used to describe these 3 groupings, such as:

1) biophysical factors (biophysical variables, physical factors, biogeophysical factors, physical land types).

2) perceptual factors (observer-related variables, social variables, observer position factors).

3) proposed activities factors (target variables).

Biophysical factors refer to naturally occurring objects and processes of an area, such as geologic landform attributes, vegetation attributes, soil attributes, etc. They are relatively static except through human actions or natural disasters.

Perceptual factors pertain to how people view the landscape and include such things as viewing distance, viewing angle, duration of view, visual magnitude, etc. They are subject to rapid change as the observer moves through the landscape.

Proposed activities factors deal with specific landscape alteration activities and the associated impacts, such as a timber harvest and its deviation from form, line, color and texture in the surrounding landscape. These factors may be mitigated with increased planning, design, and implementation costs.

VAC analyses vary according to project requirements. Flexibility is accomplished by careful selection of the factors to be considered. Given current data manipulation technology, the approaches including dozens of factors would be cumbersome when applied to broad-scale planning levels, but efficient and effective when used in project scale work. Conversely, the approaches involving just one group of factors lend themselves more readily to broad-scale land planning efforts. Obviously, the planning and design of project scale work may require data concerning just one or several factors to determine visual absorption capability, depending upon project requirements and sensitivity.

The following list identifies examples of these factors.

Biophysical Factors
Slope
Vegetative pattern & diversity
Vegetative screening ability
Site recoverability
Soil color contrast
Landform diversity
Waterform diversity
Land stability
Soil erodibility

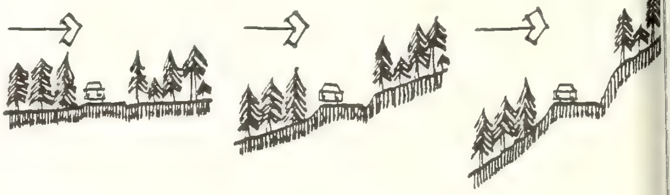
Proposed Activities Factors
Scale
Configuration
Duration
Frequency

Perceptual Factors
Distance
Visual magnitude
Slope relative to observer
Aspect relative to observer
Number of times seen
Number of viewers
Duration of view
Focal point sensitivity
Lighting
Seasons

The effect of each factor, such as slope, can be expressed in a continuum or range of visual absorption capability from low to high.

Biophysical Factors

Figure 1--The most universally accepted biophysical VAC factor is slope. As slope ratio increases, the visual absorption capability decreases.



Vegetative pattern and diversity increase visual absorption capability. As vegetative screening increases, VAC increases. (figs. 2, 3)

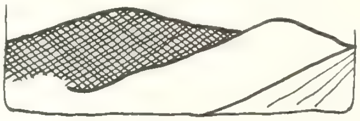


Figure 2--Brush covered hills with no pattern and little screening ability have low VAC ratings.

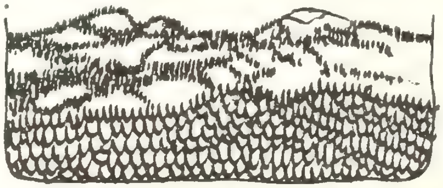


Figure 3--Tall dense stands of conifers interspersed with barren areas and rock outcrops have high VAC due to the screening ability of the trees and the pattern in the landscape.

Lands with the highest contrast between soil color and the surrounding landscape have the lowest VAC. (fig. 4)

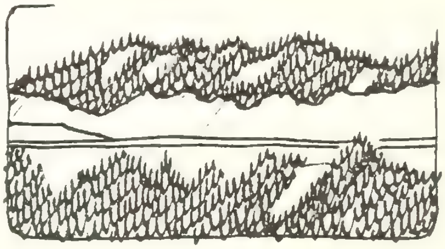


Figure 4--Disturbed landscapes that can revegetate quickly usually will have a high absorption capability. This is known as site recoverability.

Perceptual Factors

The most frequently used perceptual factor is observation distance. As distance from the observer to the activity increases, VAC generally increases.

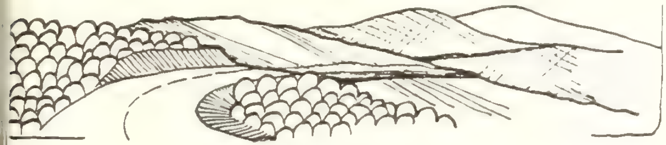


Figure 5--A road appears differently in foreground, middleground and background distances.

Visual magnitude is a VAC factor that combines slope relative to observer, aspect relative to observer and distance. It is capable of numerical measurement by computer.

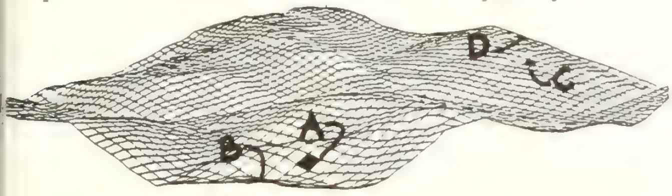


Figure 6--Cell A has a very low absorption capability because of its close proximity and its tilt toward the observer.

Cell B, although closer, has a higher absorption capability since it is tilted nearly on edge to the observer.

Cell C has a lower absorption capability than Cell B, despite its greater distance because it is tilted toward the observer.

Cell D has the highest absorption capability because of its distance and its tilt away from the observer. However, Cell D also appears to be on the ridge line. Care must be taken not to disrupt the silhouette against the skyline.

The amount of planning and design input necessary for a landscape activity will be indicated by the VAC rating. For instance, these landscapes (fig. 7, 8) have relatively low VAC with moderate slopes, little vegetative screening, high soil color contrast and close scrutiny by large numbers of concerned viewers.

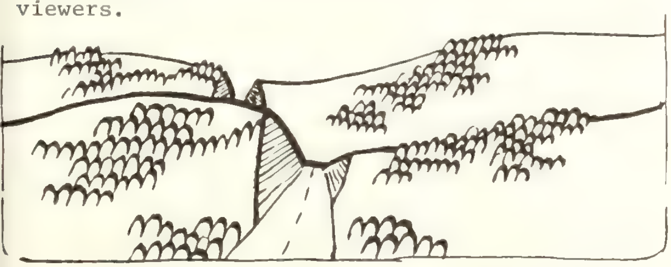


Figure 7--A standard road design introduces disruptive focal points. The early recognition of the low VAC of this landscape would identify the need for special design consideration.

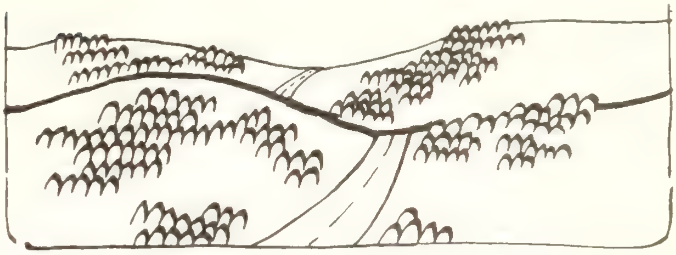


Figure 8--A well-planned, sensitively designed road can harmonize with the surrounding landscape.

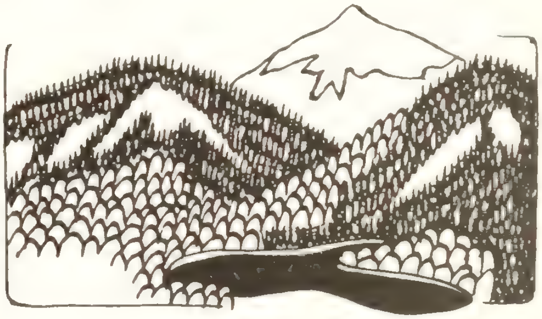


Figure 9--Areas near landscape focal points have lower capabilities to absorb alterations because they are subjected to closer viewer scrutiny.

Proposed Activities Factors

VAC varies with the visual characteristics of the landscape alterations, such as trail construction, clearcutting, or strip mining.

The scale, configuration, predicted contrast, duration and frequency of a proposed activity interacts with the biophysical and perceptual factors of the landscape to indicate how much impact the activity will have and/or how much planning and design will be required to blend the activity in with the landscape.

Generally, as the size of an activity (such as a clearcut) increases, the project area's VAC decreases. As the duration of the visual impact increases, VAC decreases. For example, the impact of a hydroelectric dam and reservoir may last virtually forever, while a wildlife habitat improvement which crushes existing brush to stimulate lower growing browse may visually impact an area for only a year or two. The reservoir changes VAC completely, whereas the habitat improvement would probably not alter VAC.

VAC APPLICATION ON THE KLAMATH NATIONAL FOREST

The Klamath VAC inventory was designed in 1977 to provide input to the 10-year Timber Management Plan for the entire Forest. The issues which were to be addressed by the plan included intensive development of new road systems and intensive timber management activities such as clearcutting and broadcast burning. The visual quality objective inventory was underway during the formulation stages of the T.M. plan. However, there was no indication of the practicality of meeting the VQO's. An overview of the visual absorption capability of the entire Forest indicated that it would be easier to meet VQO's in the Northeast Volcanic province than in the Klamath-Siskiyou province. This was due in large part to the rugged topography in the Klamath-Siskiyou. Because of the site specific nature of the various resource inventories which were being prepared for the T.M. plan, a detailed VAC and VQO analysis was undertaken for the entire Forest.

A determination of appropriate factors was the first step in the VAC inventory. Factor selection is determined by many things, including the planning level, time, money and manpower available, and the desired final product or interpretation. Factors for a VAC analysis of urban development in New England landscapes would obviously be different than factors for a VAC analysis of timber management in Northern California. Generally, the larger the area to be studied and the shorter the planning period, the fewer the number of VAC factors which can be incorporated into the study.

We chose to limit ourselves to only biophysical factors on the Klamath National Forest. There are several reasons for this decision.

First, we know that perceptual factors were already included in the visual quality objective mapping process (user sensitivity and viewing distance). Since our end product is a merge of VQO's with VAC ratings, we think that inclusion of perceptual factors in the VAC process would lead to unnecessary duplication and double weighting of these particular factors.

Secondly, we wanted to develop a VAC system which utilizes biophysical factors that are responsive to activities addressed in the T.M. plan; i.e., intensive timber harvesting, broadcast burning, and road construction on steep mountainous terrain. Additionally, the data for these biophysical factors were readily available and were cost effective to use; they could be assembled into a VAC map in a timely fashion for the T.M. plan as well as for land management planning and project planning.

The four biophysical factors we used to determine visual absorption capability are: 1) slope, 2) vegetative screening and pattern, 3) site recoverability, and 4) soil color contrast. The arithmetic formula to determine VAC is as follows:

Slope + Vegetative Pattern and Screening +
Site Recoverability + Soil Color Contrast
Visual Absorption Capability

As an example of the Klamath VAC process, if a particular landscape has 1) flat slopes, 2) interesting vegetative patterns and tall trees for visual screening, 3) good vegetative recoverability after a disturbance, and 4) low soil color contrast, then this landscape has high visual absorption capability. Conversely, a landscape with steep slopes, a uniform brushfield with no patterns, poor site recoverabilit and white or red soil colors in a green landscape, would have low VAC. Of course, many possible combinations exist for these four factors.

To arrive at VAC ratings for Klamath National Forest lands, arithmetic values were assigned to the four VAC factors. For example, slope was stratified into four classes with VAC values ranging from 0 to 9. Vegetation pattern and screening were determined from the timber type maps and given values from 0 to 6. Site recoverability and soil color contrast were interpreted by the soil scientists from their Soil Resource Inventory and were classified for VAC from 0 to 3 and 0 to 4, respectively.

These ranges of values were selected after extensive analysis and field verification. Slop received the most points because of the steep nature of the Klamath-Siskiyou mountains, where slopes can vary from 0 to 150%. The 4 slope classes were chosen because they approximate distinct visual slope breaks and because they correspond to various road building and timber harvesting techniques.

Vegetative pattern and screening data were only on a Forest-wide basis on the existing timber type maps. Tree species and size classes which is the height of trees, give information about the screening ability of that vegetation. Crown closure percentages were the best approximation of vegetative patterns forest-wide. Differences exist in the patterns and screening ability of various commercial tree species, non-commercial hardwoods and brush. Based upon repeated field investigations, we stratified vegetation pattern and screening according to species, size class, and crown closure with values ranging from 0 to 6.

After the factor selection and evaluation process was completed for the T.M. plan, the four factors were then mapped at the same scale as the VQO's (1:24,000). A composite score based on the aggregate of the values was assigned to that piece of land for its various biophysical characteristics. Following are the criteria and values for each of the VAC factors:

SLOPE	VAC Value
0-20%	9
20-40%	7
40-60%	4
60% +	0

VEGETATION PATTERN and SCREENING

Pine/Douglas Fir/Mixed Conifer

	Crown Closure:	0-30%	30-70%	70% +
Size Class	0-1	0	0	0
	2	1	3	2
	3	2	4	3
	4-5	3	5	4

Red Fir/White Fir

	Crown Closure:	0-30%	30-70%	70% +
Size Class	0-1	0	0	0
	2	1	3	2
	3	3	5	4
	4-5	4	6	5

Hardwood

	Crown Closure:	0-30%	30-70%	70% +
Size Class	0-1	0	0	0
	2	1	3	2
	3	2	4	3

Brush/Grass/Barren/Open

	Crown Closure:	0-30%	30-70%	70% +
S.C.	0-1	0	0	0

SITE RECOVERABILITY

Duncan Dunning	Recoverability from S.R.I.	VAC Value
A	High	3
I		
II		
III	Moderate	2
IV	Low	1
V	Non-Commercial	0
Non-Comm.		

SOIL COLOR CONTRAST

	VAC Value
Least: Dark-gray, blue-black or dark brown on green landscape.	4
Some: Light-gray, brown, or red-brown on green landscapes; or red on red landscapes.	2
Most: White or red on green landscapes.	0

For example, if a particular landscape has the following characteristics:

Slope = 20-40%
Veg. = Red Fir, 30-70% crown density,
medium sawtimber
Site = Duncan-Dunning Site Class 2
Soil Color Contrast = dark brown on green,

then the VAC = 7 (slope) = 6 (veg.) = 3 (site) + 4 (soil color contrast) = 20.

The VAC rating can range from a low of 0 to a high of 22. VAC ratings have been stratified into four general categories, High (17-22), Moderate (11-16), Low (7-10), and Very Low (0-6). Originally, there were only 3 categories of VAC: High (17-22), Moderate (11-16), and Low (0-10). Our field investigations highlighted the need for a further breakdown within the low category. There is a significant difference between VAC ratings of 0 to 6 and 7 to 10. Therefore, a very low category was created.

These breakdowns are responsive to visual differences in absorption capabilities of the landscape, rather than statistical rankings or bell curve distributions.

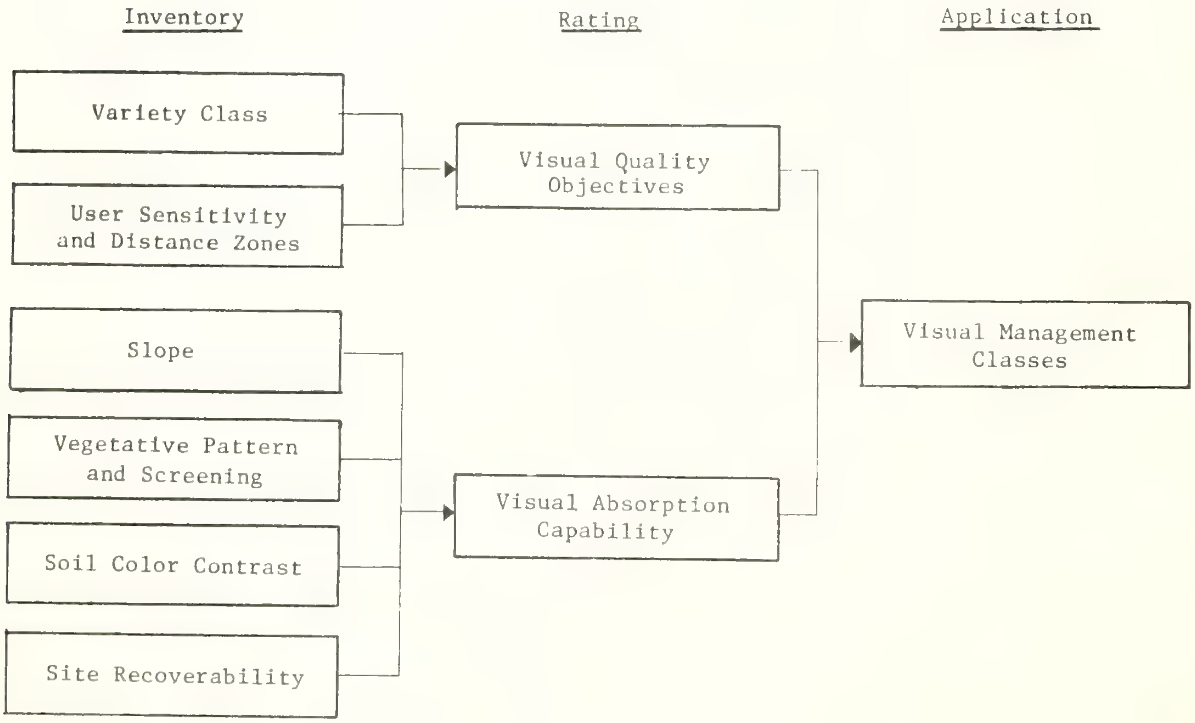
On the Klamath National Forest, we have mapped VAC primarily for broadscale planning. Consequently, our cost estimates are based on this level of work. Our experience on the Klamath is based upon two different VAC mapping techniques, one in which we assembled our own data base using existing information, and another in which we utilized a data base originally developed for land management planning.

We were able to map a range of 5,000 to 10,000 acres per person-day, assembling our own data base using existing information. As the landscape complexity increases, the number of acres/day mapped for VAC decreases. Other factors affecting cost of VAC mapping are the number of factors considered, the availability of data, and accessibility into the landscape.

Utilizing a soil vegetation data base developed for forest planning, we were able to make VAC interpretations at the rate of 50,000 acres/person-day. All of the biophysical factors required for Klamath National Forest VAC mapping process were assembled into soil-vegetative response units by Forest Soil Scientists at our request. Our interpretations were made from these response units and field checked for accuracy. This procedure is cost-effective onl when variables necessary for a VAC analysis are included in an existing data base. It is imper tive to spot field check areas for accuracy and consistency.

For project level work, we would expect th number of acres/day mapped to decrease, but the level of accuracy to increase, due to additiona VAC factors which will be analyzed and the specific site and type of activity planned.

The end product of the visual resource analysis on the Klamath is a visual management clas (VMC) map and guidelines for visual resource management. A VMC map consists of a discrete visual quality objective, distance zone and visual absorption capability rating. Visual management classes stratify landscapes in a continuum from visually vulnerable to visually tolerant. The most visually vulnerable landscape is "retention-foreground-very low VAC." and the most visually tolerant landscape is "maximum modification-seldom seen with a high VAC." The following diagram explains the relationship between VQO's, VAC, and VMC's.


Inventory
Rating
Application
Variety Class
User Sensitivity and Distance Zones
Visual Quality Objectives
Slope
Vegetative Pattern and Screening
Soil Color Contrast
Site Recoverability
Visual Absorption Capability
Visual Management Classes

CONCLUSION

Based on our experience in mapping and using VAC for the Forest land and resource management plan. In the future, we will consider vegetative pattern separately from vegetative screening. This is because the crown density from the timber type maps is not the best evaluation of pattern. Aerial photos, orthophoto maps, and field checking are better sources of vegetative pattern rankings.

On the Klamath National Forest, the VAC system utilizes a data base which is common to all disciplines involved in land management planning. This has allowed us to integrate and coordinate our concerns with other disciplines involved in the planning process. It has also been effective in the Klamath National Forest land management planning process because it has allowed timely consideration of the visual impacts associated with various resource activities.

The Klamath VAC system has been extensively field checked for accuracy and applicability by U.S. Forest Service landscape architects representing a variety of experience and geographical location. It has been effective in identifying lands with both low and high absorption capability. This has allowed us to emphasize increased resource utilization in areas with high absorption capability and decreased utilization in areas with low absorption capability. The end result is further resource utilization compatible with visual resource values.

VAC offers land managing agencies the opportunity to assess the intrinsic and extrinsic characteristics of an area of land to absorb visually various resource activities. We expect it to become a standard inventory item in future landscape assessment projects.

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A Proposed Biophysical Approach to Visual Absorption Capability (VAC)[1]

W.C. Yeomans[2]

Abstract: In British Columbia, visual analysis is in its formative stages and has only recently been accepted by Government as a resource component, notably within the Resource Analysis Branch, Ministry of Environment. Visual absorption capability (VAC), is an integral factor in visual resource assessment. VAC is examined by the author in the degree to which it relates to interdisciplinary biophysical assessments presently carried out by the Branch. Such assessments encompass the disciplines of soils, surficial geology, aquatics, vegetation, wildlife, outdoor recreation and climate. A conceptual framework for developing a proposed system of applying these data to an overall mapping system for visual absorption capability in the Province is set forth and a sample case study selected for pilot study purposes.

INTRODUCTION

This paper concerns itself with the development of a proposed methodology for developing visual absorption capability assessments, using the biophysical land classification system as presently carried out within the Resource Analysis Branch in British Columbia. Current biophysical terminology is briefly examined, followed by VAC terminology and design factors. Relationships existing between the two are then explored. A proposed system of application, using an interdisciplinary team approach in relating biophysical ratings to the VAC assessment, is set forth. A case study is then hypothesized. This is followed by a summary of how the system could be applied in British Columbia as the Province moves towards a greater recognition of the visual resource as needful of evaluation, not only in the preliminary mapping stages, but the degree to which it must be considered at any final environmental impact level.

BIOPHYSICAL LAND CLASSIFICATION AND THE RESOURCE ANALYSIS BRANCH

The biophysical classification program is a building block process that encourages the integration of physical and biological data (landforms, surficial materials, soils, climate, vegetation and organisms) to form "ecologically significant" units of the landscape. The process involves the delineation of various terrain, aquatics and climatic phenomena, each of which is an end point for the appropriate discipline, but, when combined, provides the basis of the biophysical map unit (Smith 1969).

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[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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Biophysical mapping is initially based on air-photo interpretation where *visually* different units of land are identified and differentiated. These landscapes, due to differences in landform and vegetation pattern (texture, in visual terms) are the basis for depicting biophysical units. As such, biophysical units are also significant to visual management, since visually significant features and biophysically significant characteristics are often similar.

Biophysical inventories within the Branch are generally conducted at a reconnaissance level (1:50 000 base) with more detailed inventories carried out only where high values for more than one resource prevail or when intensive management is justified. This scale appears to be suitable for most VAC assessments as well.

The analysis of biophysical data can be complex or simple; it can range from manual overlay mapping, to sophisticated computer technology. Similarly, visual absorption capability data can be evaluated at any degree of simplification or complexity (Benson 1978). Basic to the system are the following components - all represented within the Branch:

Subject Areas of Biophysical Base Maps

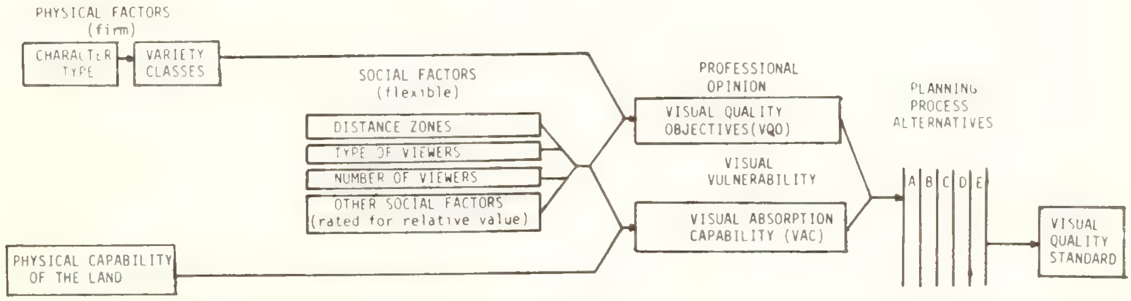
1. Climate
2. Terrain
3. Soils & Topography
4. Aquatics
5. Vegetation and Forest Cover
6. Wildlife

Within the above categories, numbers 2, 3, and 5 are most applicable to VAC assessments, although selected data may be drawn from climate, aquatics and wildlife as well. This will be demonstrated in the proposed classification system outlined later in this paper.

VISUAL ABSORPTION CAPABILITY

Visual absorption may be defined as the physical capacity of a landscape to absorb proposed development or management activities and still maintain its inherent visual character and quality. Two of the most important factors affecting the absorption capability of a landscape are: 1) the degree of visual penetration, i.e., the distance into the landscape you can see from a vantage point and 2) the complexity of the landscape. The degree of visual penetration is affected both by vegetation and topography (Anderson *et al*. 1977). Landscape complexity refers to topographic extremes, vegetative diversity, climatic variations and heterogeneous regional characteristics - all prevalent in British Columbia. The capability to accommodate management impacts (development, logging, roads, transmission lines, etc.) and still maintain visual quality standards depends largely on biophysical factors. Social and economic parameters enter the scene at more subjective levels and involve management decision highly dependent upon inherent physical (biophysical) capacities of

Figure 1 *The Visual Management System (After U.S.D.A. Forest Service Manual)*


PHYSICAL FACTORS (firm)
CHARACTER TYPE
VARIETY CLASSES
SOCIAL FACTORS (flexible)
DISTANCE ZONES
TYPE OF VIEWERS
NUMBER OF VIEWERS
OTHER SOCIAL FACTORS (rated for relative value)
PHYSICAL CAPABILITY OF THE LAND
PROFESSIONAL OPINION
VISUAL QUALITY OBJECTIVES(VQO)
VISUAL VULNERABILITY
VISUAL ABSORPTION CAPABILITY (VAC)
PLANNING PROCESS ALTERNATIVES
A
B
C
D
E
VISUAL QUALITY STANDARD

the land for the resolution of visual quality objectives.

VAC Principles

Basic principles governing VAC analysis can be summarized as follows:

1. All lands vary in their ability to absorb modifications.
2. Areas near landscape focal points have lower capabilities to absorb modification.
3. The higher the complexity/diversity of the landscape, the higher its visual absorption capability.
4. Landscape edges, i.e., breaks between forest and meadow, lakeshore etc., have high VAC due to their diversity of background, but low VAC due to their propensity to become focal points.
5. Ridgetops are most likely to have low VAC due to consequent scrutiny as focal points, e.g., observer position[3] is generally "inferior" or lower. Lands visible from a greater number of observation positions will have lower VAC.
6. Lands with the highest soil color contrast have the lowest VAC since development may expose soils by side casting, stockpiling, etc.
7. VAC ratings should consider regional topographic, geomorphic and climatic parameters on a relative basis, i.e., VAC ratings will vary between regions and sub-regions.
8. Lands with geologic stability and good growing conditions may have moderate to low VAC if vegetation is lacking or monotonous and uniform, but high VAC in the long run due to good regeneration rates and stable soil conditions.
9. Uniformly tall, dense stands of trees have high VAC due to screening ability, i.e., high VAC when in foreground but lower VAC when in background.

Relationship Between Biophysical and VAC

Relationships existing between biophysical land classification outlined earlier and VAC become apparent when physical factors leading to VAC evaluations are specified. Essentially these are:

> Slope, vegetative pattern, color and diversity, vegetative screening ability, site recoverability, soil color contrast, landscape diversity, land stability, waterform diversity and soil erodibility.

This paper will confine its objectives to an analysis of biophysical factors, rather than discussing social and economic factors relative to visual absorption capability. There are several good reasons for this. First, biophysical factors are relatively more constant over time than social and economic considerations and thus lend themselves more readily to inventory and analysis; and secondly, visual analysis is often carried out in areas where social factors arising out of proposed new developments are in a state of flux - political or otherwise - and thus more difficult to assess in the context of VAC. Public preferences for landscape types may also change over time.

The most generally accepted physical VAC factor is slope, for as the slope of a seen area increases, VAC decreases (Anderson *et al.* 1977). Vegetation composition, screening ability, color diversity and regeneration rates are also extremely important, for as they increase or become viable, VAC increases. These determinants are readily available from Resource Analysis Branch biophysical maps.

Soil erodibility, soil color and soil stability - data readily obtainable from most soil reports - are also important factors relative to VAC, since exposed cut banks, overburden, side casting (man induced) and naturally unstable or eroding slope faces may contrast sharply in color and texture with the surrounding natural landscape.

The Mapping Process

Let us now examine (1) relationships existing between VAC and biophysical mapping and (2) possible methods of incorporating VAC evaluations with other disciplines in the mapping process.

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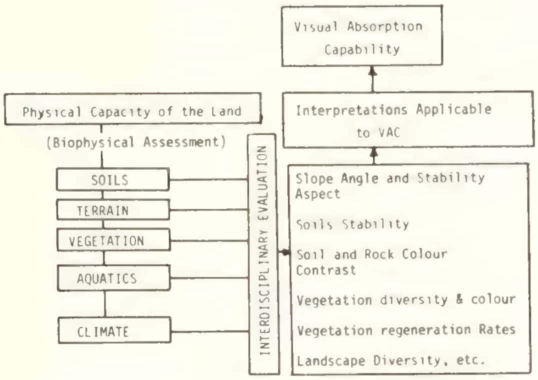
[3] Observer Position: a term employed to describe observer's relationship to this visual objective within the landscape. Three terms are used: observer inferior (viewer below object), observer normal (viewer on level with object), and observer superior (viewer above object).

In addition to biophysical mapping as outlined, the Resource Analysis Branch now conducts recreation carrying capacity studies (Block 1976) based principally on vegetation, soil, and surficial geology characteristics and limitations. Of specific interest to VAC are the identifications of major limiting factors to recreation use based upon soil texture, soil depth, drainage, flooding, vegetation density, vegetation diversity and sensitivity to development. Man-made constraints are also categorized in the landscape. In fact, the recreation carrying capacity classification is the most appropriate system utilized within the Branch for "expanding" into VAC ratings and has been selected for demonstration purposes as shown in the hypothetical mapping example (fig. 5).

Prior to setting forth a proposed system of VAC mapping based on biophysical factors, I have developed an expansion of figure 1 as follows:

Figure 2 *Carrying Figure 1 one step further, the Visual Management Flow Chart may be expanded in its biophysical and Vac sections.*


Visual Absorption Capability
Physical Capacity of the Land
(Biophysical Assessment)
SOILS
TERRAIN
VEGETATION
AQUATICS
CLIMATE
INTERDISCIPLINARY EVALUATION
Interpretations Applicable to VAC
Slope Angle and Stability Aspect
Soils Stability
Soil and Rock Colour Contrast
Vegetation diversity & colour
Vegetation regeneration Rates
Landscape Diversity, etc.

A PROPOSED SYSTEM OF VAC ASSESSMENT BASED ON BIOPHYSICAL MAPPING CAPABILITIES

Having briefly examined the biophysical approach as utilized by the Resource Analysis Branch and its implications to VAC, the following basic structure is proposed as a beginning framework leading to VAC classification. The system will, of course, require considerable field testing, modification and refinement, but the ingredients to its application are readily available. Three major phases would be involved:

1. assessment of the macro area by satellite photo examination (and 1:250 000 mapping if available) and 80 chain photos to determine basic physiographic (regional) characteristics,
2. development of guidelines for visual assessment of each project on a regional or sub-regional level based upon homogeneity within the characteristic landscape,
3. a collation, or "drawing" from present or past biophysical mapping carried out by individual disciplines, thus leading to a VAC rating system which could then be checked by further air photo analysis and field review.

Basic Assumptions

Although social and economic factors do not come under detailed examination in this paper, some evaluation of viewer response is essential in the preliminary mapping phase. Among the more significant of these are the following assumptions.

At all times, the VAC biophysical ratings should relate to and be conditioned by the following:

1. that the mapped area is under constant or periodic viewer involvement or will come into view subsequent to a proposed development impact (corridor alignment, roads, hydro lines, mining, townsite development, outdoor recreation use, etc.).
2. That, if not seen at present (much of British Columbia), the following baseline concept should govern mapping priorities: river basins or valley corridor benchlands are more likely to be utilized for access and development than adjacent uplands, ridgetops or areas of rugged topography.
3. that visual impact of management activities usually increases as viewing distance decreases and vice versa and that areas seen from destination points are generally of more concern than those seen from access routes.

When development is actually proposed, viewer position (superior, inferior or normal) will be assessed prior to final VAC evaluation. It is also important to point out that VAC assessments prior to development can lead to a more realistic route, corridor or development alternative, and are preferable to "after the fact" assessments.

Governing Factors

Five primary factors govern VAC bio-physical ratings: (1) slope, (2) vegetation regeneration potential, (3) landscape diversity, (4) soils erosion potential and (5) soils and rock color contrast potential (Vold 1979). These are defined as follows:

1. Slope
    - slope stability
    - slope: angle of repose
    - slope as viewed from superior, inferior, and normal viewer positions
2. Soils
    - erosion potential (leading to exposure)
3. Vegetation
    - regeneration potential - soil fertility and macro climatic factors
4. Soil and Rock Color Contrasts
    - low to high contrast with characteristic landscape cover
5. Landscape Diversity
    - vegetation density, diversity, pattern and screening potential: successional characteristics
    - landform/land use diversity (slopes, valleys, ridges, urban and rural areas, etc.)
    - waterform interest and diversity
    - visual features of interest and/or significance

Utilizing the above five factors, the following rating system would govern all VAC evaluations, i.e. VAC = S x (E+R+C+D) where S = Slope, E = Soil Erosion, R = Vegetation Regeneration Potential, C = Soil and Rock Color Contrast Potential, and D = Landscape Diversity.

A rating system would then be established as follows (Table 1), where the highe number carries the highest VAC.

Table 1

Factor	Conditions	Rating
1. (S) Slope (dominant and determining factor)	0 - 5 percent slope	5
	6 - 15 percent slope	4
(This is a complex factor i.e. a long slope on a mountainside has a more cumulative impact than short, steep slopes in rolling topography)	16 - 30 percent slope	3
	31 - 60 percent slope	2
	> 60 percent slope	1
2. (E) Soil Erosion Potential	Low Erosion Potential	3
	Moderate Erosion Potential	2
	High Erosion Potential	1
3. (R) Vegetation Regeneration Potential	High Regeneration (generally CLI Forest Capability[4] Class 1-3)	3
	Moderate Regeneration Potential (generally CLI Forest Capability Class 3-4)	2
	Low Regeneration Potential (generally CLI Forest Capability Class 5-7)	1

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[4] CLI - Canada Land Inventory, 1965-70. In forest biomes, vegetation potential is generally related to forest productivity (capability).

4. Soil and Rock Color Contrast	Low Contrast (e.g., 2.5 or less hue on Munsell Colour Chart)	3
	Moderate Contrast (e.g., 5 hue change)	2
	High Contrast (e.g., greater than 5 hue change)	1
5. Land Use/Landscape Diversity	High Diversity of vegetation types; diverse and interesting topography and attractive water bodies	3
	Moderate diversity (little variety in vegetation or topography present)	2
	Low Diversity (no significant change in vegetation pattern or topography present)	1

It becomes apparent that, since VAC values can vary from a low of 1 x (1+1+1+1) = 4 to a high of 5 x (3+3+3+3) = 60, VAC ratings can be assigned as follows:

Very Low VAC= 4-15 Low VAC = 16 - 27	Complexed to "low" VAC: allows subjective variation and room for value judgements relative to specific projects.
Moderate VAC= 28-40	"Moderate": no change
High VAC = 41 - 50 Very High VAC=51-60	Complexed to "high" VAC: allows subjective variation and room for value judgements, as above

Example

A landscape area or unit on 16 - 30 pct. slopes with a low erosion potential due to coarse textured, but stable materials with low regeneration potential due to soil droughtiness, low color contrast due to limited soil leaching and high landscape diversity due to open, parkland conditions, would carry a rating as follows: VAC = 3 x (3+1+3+3) = 30, or a moderate VAC rating.

A Proposed System of Classifications

Carrying the VAC assessment into a proposed class system incorporating the previously stated assumptions and with assigned biophysical ratings, I would propose the following class definitions:

Class I (VAC biophysical rating of 51 - 60)

Areas which are gentle to moderate in elevation, with diverse vegetation and stable soil conditions, and capable of supporting management activities with a minimum negative affect on the visual quality of the landscape: low foreground, middle ground, background impacts.

Class II (VAC biophysical rating of 41 - 50)

Areas of rolling to ridgeline topography with open to semi-open mixed and diverse evergreen/deciduous vegetation capable of supporting management activities with a minimum amount of landscape alteration (screening, site design, etc.) and having stable soils and landform characteristics.

Class III (VAC biophysical rating of 28 - 40)

Areas of moderately interesting and regionally typical landscape character, interest and diversity with varied topography restricted to slopes less than 15 percent supporting diverse vegetation. However, the topography and vegetative cover are reasonably difficult to manipulate in the interest of the visual resource.

Class IV (VAC biophysical rating of 16 - 27)

Areas of pronounced topographic eminence but lacking in diversity with slopes ranging to 30 percent and vegetation characterized by open deciduous, evergreen or shrub complexes. Management activities would be seen regard-

Figure 4 *The proposed five class system as outlined would be conditioned (and clarified) by the following which would indicate what VAC problems existed and at times where and whether more mapping, design and analysis might be needed.*

1) **LANDFORM**

Slopes in excess of 15%	S^1
High Foreground Profile	S^2
High Middle-ground Profile	S^3
High Background Profile	S^4

2) **LANDSCAPE DIVERSITY**

Uniform, lacking in variety, (vividness)	L^1
Lacking in Intactness[7]	L^2
Lacking in unity[8]	L^3

3) **VEGETATION**

Uniform: Lack of diversity	V^1
High Veg. Sensitivity	V^2
Low Regeneration Rate	V^3
Fall & Spring Colour or other plant material deficiency	V^4

4) **SOILS**

Erosion/Slope Failure	C^1
Excessive Rock & Soil Colour Contrast with Surroundings	C^2
Poor drainage	C^3
Excessive compaction	C^4

5) **WATER FEATURES**

Flooding potential	W^1
Cutbank (stream) erosion	W^2
Lack of edge diversity (Lake)	W^3
Limited by scale related to surrounding landscape	W^4

6) **MAN-MADE**

Urban features	M^1
Road, railway, Hydro line right-of-way	M^2
Surface Mining extractions	M^3
Other	M^4

HYPOTHETICAL EXAMPLE

$$3\ \begin{matrix} S^1 \\ V^{1,3} \\ M^2 \end{matrix}$$

A class three VAC area (unit) with variable topography and uniform vegetation having low regeneration rate through which a Hydro line is passing and is readily observed.

less of any mitigation measures adopted during or following development.

Class V (VAC biophysical rating of 4 - 15)

Areas of extreme topographic variation with uniform vegetation cover, or devoid of such, offering little opportunity for matching management activities with the characteristic landscape; readily observed from access routes and perhaps elsewhere; slopes in excess of 35 percent, actively failing slopes and/or very sensitive vegetation (Figure 3*).

Under the proposed system, team effort with specialists in biophysical mapping components is essential, since some degree of training in the direction of visual analysis would enable them to view visual absorption factors, both in the field and throughout the mapping and interpretive phases. The "VAC" overlay would have its own nomenclature, or system of classes, either as a separate interpretation for the visual analyst, or as a component of the total biophysical package.

Summary of Proposed Biophysical System of VAC Assessment

Step one: Determine mapping priorities i.e., where are VAC assessments needed relative to impact proposals?

Step two: Conduct preliminary air satellite and stereo pair examinations in determination of landscape units (Tetlow and Sheppard 1977).

Step three: Review basic assumptions and predict viewer response.

Step four: Map slope, vegetation soil and rock color contrasts and landscape diversity. Assign appropriate ratings from 1 to 5 (slope) and 1 to 3 (all others).

Step five: Apply the formula VAC = S x (E+R+C+D) and pre-map ratings on terrain unit complexed polygons as noted in figure 4.

Step six: Field check ratings wherever possible at a team level where soils, vegetation and aquatic specialists can verify findings.

Step seven: Draft final mapping on appropriate base followed by technical edit check by all disciplines involved.

BIOPHYSICAL VAC ASSESSMENT: ITS OPERABILITY AND POTENTIAL

The biophysical approach to VAC as outlined in this paper would be an applied methodology to all land areas rather than theoretical, preceded ideally by methodology development in the broader field of visual analysis. It is difficult to determine costs of a project but they should be relatively low in comparison to benefits gained, being largely a matter of staff orientation and some added field travel and interpretation time.

The technology could be of great assistance to British Columbia and elsewhere in conducting visual corridor analysis, urban suitability studies, joint research with other agencies, forest harvesting, environmental impact assessments, and highway, hydro electric and other alignment studies before visual impact takes place. The extent of transferability should be virtually 100% since it could be applied to a common land base anywhere, providing of course, that an assembly of biophysical data is readily available. A very appreciable advantage of the biophysical approach to VAC assessment is that a relatively low cost reconnaissance provides the basis for determining where detailed work will be required in the design, management, and implementation phases of any proposed development management activity. One can then apply development funds where they are most effective and have a reasonable idea in broad terms of funds needed for the project.

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*See color illustration on page 389.

Automated Cartography and VAC

The system of mapping as outlined lends itself to automated cartographic techniques. The data could be digitized separately or incorporated with soils, recreation, or vegetation field data cards. Larger systems, such as I.G.D.S.[5] could be used for interactive mapping and automated cartography involving soils, vegetation, terrain, aquatics, climate, etc., (for planning, management, interpretation and derivative mapping).

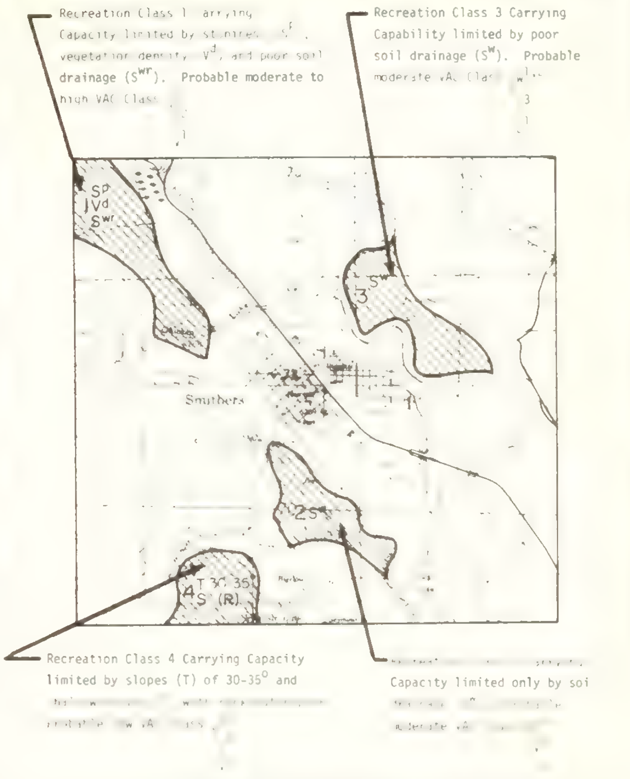
Mapping Examples: Other Systems

There are no examples of the above proposed system of analyzing VAC factors within British Columbia. However, certain corridor studies have been conducted in the United States, i.e., Smith River, U.S. Forest Service, (U.S.D.A. Forest Service 1973) where VAC overlays were made on separate soils, vegetation, climate, and hydrology interpretive bases. The recent Vail Pass study (Colorado Department of Highways 1979) is an excellent example of a team effort in this direction, although specific study methods were not outlined in that report.

CONCLUSIONS

Visual resource evaluation has only recently come under serious investigation in British Columbia, where a relatively low population resides within an extensive land base and management activities have usually been favored for their economic returns more than their aesthetic - and in this case - visual content.

Figure 5 A hypothetical example of Recreation Carrying Capacity with probable VAC ratings based upon a biophysical classification system.


Recreation Class 1 Carrying Capacity limited by stoniness (S^p), vegetation density (V^d), and poor soil drainage (S^wr). Probable moderate to high VAC Class
Recreation Class 3 Carrying Capability limited by poor soil drainage (S^w). Probable moderate VAC Class
S^p V^d S^wr
3 S^w
Smithers
2 S^w
4 T 30-35 S (R)
Recreation Class 4 Carrying Capacity limited by slopes (T) of 30-35° and
Capacity limited only by soi

In 1975, the Resource Analysis Branch initiated visual resource evaluation as an additional component within its complex of environmental disciplines. It is the intention of the Branch to integrate fully the inventory of visual resources with its other work. The methods for pursuing this are outlined in this paper. Resource Analysis Branch interdisciplinary teams now service requests for technical mapping and interpretations within such areas as urban suitability, terrain assessments for corridor development, climatic network services, stream fish and aquatic capabilities, outdoor recreation features and carrying capacity, vegetation, wildlife biophysical mapping and other related studies required by government agencies faced with land allocation and disposition decision making. These studies are supportive of the VAC evaluation and should contribute greatly to its implementation.

The Resource Analysis Branch is in an unique position to support an objective approach to VAC analysis, i.e., biophysical data collected by disciplines on an interactive basis, within one administrative complex and "under one roof" This is supportive - in fact essential - to the system of VAC mapping proposed in this paper. Access to photos, air satellite photography, instrumentation, (stereoscopes, slides, projectors, digitizers, computers, etc.) and mapping and report production facilities is commonly shared by Branch professionals. A great deal of inter-action also prevails in seminars, workshops, and at the level of informal dialogue.

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[5] Interactive Graphic Design System. The Resource Analysis Branch will be moving towards use of this system in 1979-80.

Our task, in British Columbia at least, is to develop a visual mapping methodology that could be utilized by all resource management agencies, consultants and the academic community in conducting or communicating visual resource assessments. Some exploratory work has already been done in this area, notably within the N.E. Coal Study area (Tetlow, Sheppard 1975) where a detailed Landscape Unit Analysis involving visual vulnerability evolved. Later work by Horner (1979) takes a more pragmatic look at terrain and vegetation in biophysical terms as they reveal VAC factors in the landscape.

The framework is here: biophysical mapping carried out at a team level. What is now needed is refinement of the mapping concepts, initiating pilot study assignments and continuing to solicit technical criticism as the process evolves.

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The Visual Information System[1]

Merlyn J. Paulson[2]

Abstract: This paper outlines a project level process (V.I.S.) which utilizes very accurate and flexible computer algorithms in combination with contemporary site analysis and design techniques for visual evaluation, design and management. The process provides logical direction and connecting bridges through problem identification, information collection and verification, visual evaluation, design development, management prescription development and periodic review. V.I.S. introduces sophisticated new algorithms for data verification and visibility, view quality, and topographic and visual slope and aspect determinations; a logical procedure for user and expert preference and sensitivity testing, and a graphic analysis system for the identification of form, line, color and texture related anomaly detection and mitigation design criteria at a site scale.

INTRODUCTION

Visual quality analysis and design processes have evolved as creativity, new technology and common sense have merged to provide the means to challenge and improve them. Few disciplines are caused to cover a similar range of the interactions of the sciences and the arts. A detailed assessment of the interworkings of the socio-economic-physical environment must be followed by applications of interactive principles of art, design implementation and management to form the necessary complete process. Dynamic and iterative analysis/design systems have created opportunities for flexible and efficient evaluative procedures which are defensible to the public and beneficial to the designer. It has remained an important goal during the development of the Visual Information System to embody these important segments in a holistic rather than atomistic manner.

THE V.I.S. PROCESS[3]

The V.I.S. process is diagrammed in figure 1.0. It consists of five general phases, each of which contains a number of specific procedures. The entire process is initiated by a proposal for physical change, in which it is assumed that a visual evaluation, design or management prescription is a requirement.

Phase I: Overview

Phase one consists of the project overview. The assumptions under which the project is undertaken are identified and the proposed changes documented and defined in terms of time and space. The administrative coordination of the project, the project schedule and information sources are established and verified.

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[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resources, Incline Village, Nevada, April 23-25, 1979.

[2] Merlyn J. Paulson is Assistant Professor of Landscape Architecture, Colorado State University and President of MJP ASSOCIATES, INC. of Fort Collins, Colorado.

[3] The Visual Information System process has been developed in visual quality analysis research and professional work conducted by Merlyn J. Paulson, with original conceptual guidance from Carl F. Steinitz, Harvard University, and the later assistance of Daniel Oetting, John Schock and many students of Landscape Architecture at Colorado State University.

Phase II: Data

Phase two involves the identification of the project study area and the collection of information relevant to the project. The project study area encompasses all of the proposed physical changes and geographic areas which can, at this stage, be identified as exerting or receiving visual influence.

Two "grid maps" of information are required for the computer-aided evaluations of visibility, view quality, slope, aspect, duration and view impact. These include: 1) the topography, in multiples of feet, as shown in figures 2.0 and 2.1; and 2) the visual surface pattern, as shown in figure 2.2.

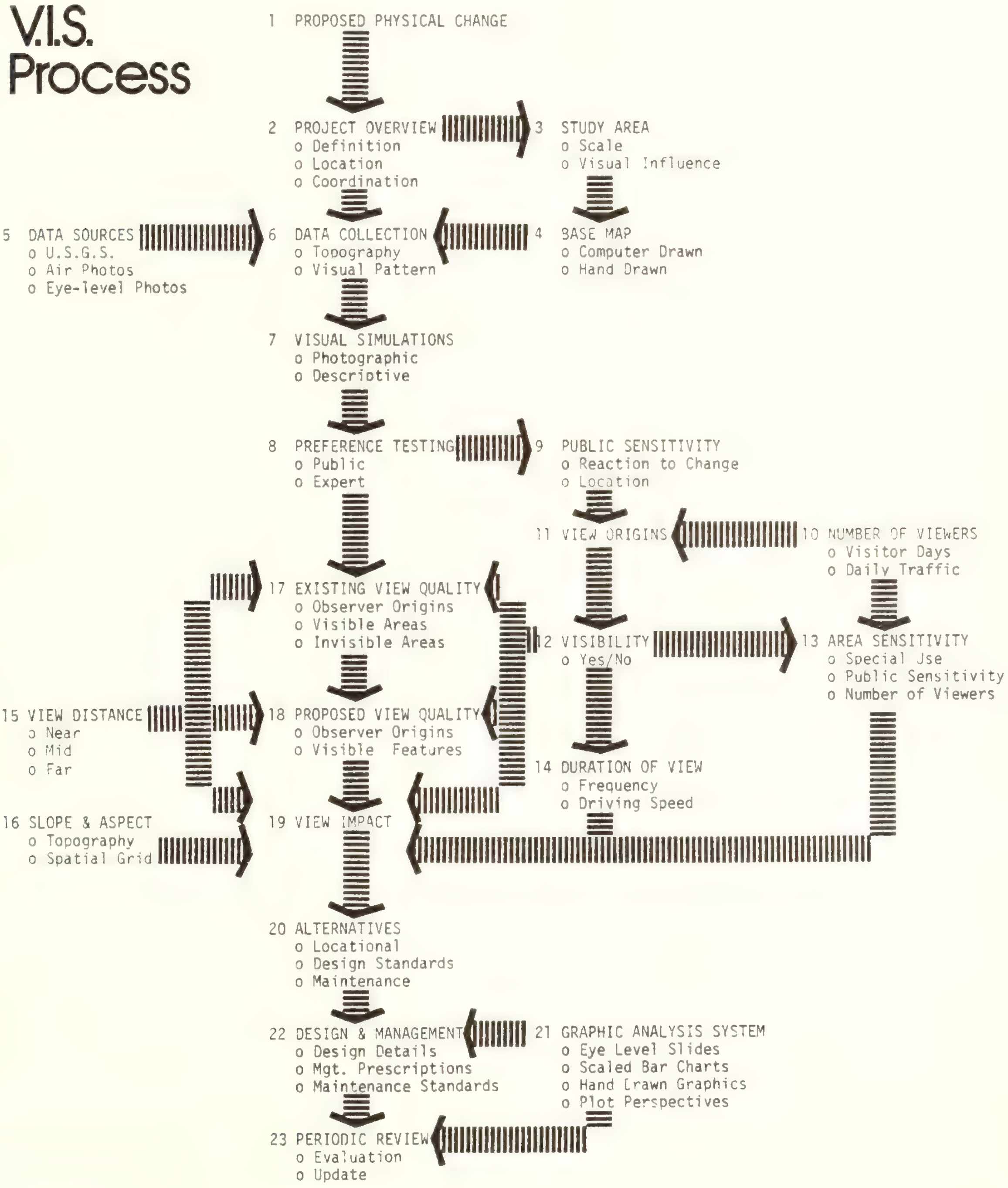

Figure 1.0--*The V.I.S. process diagram.*

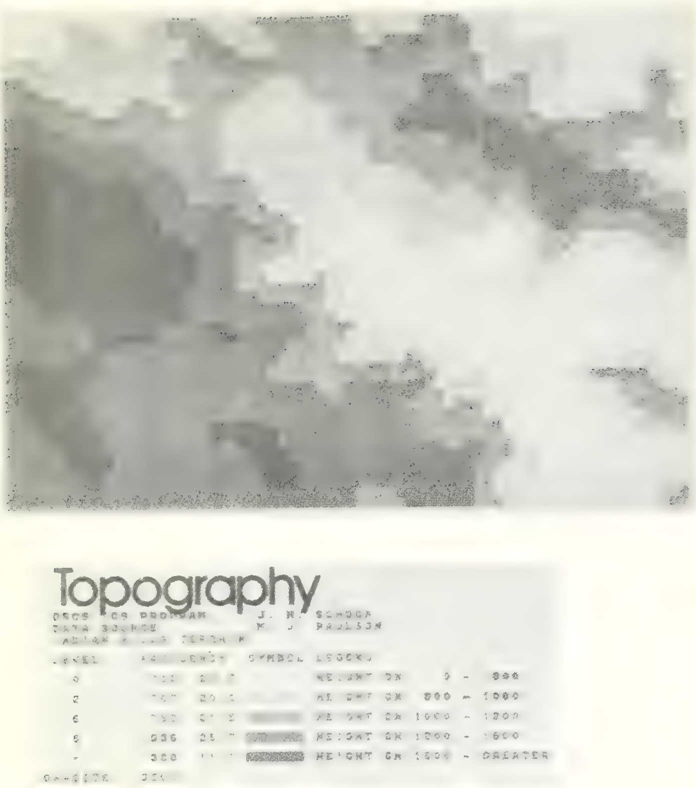

Figure 2.0--*Topographic Elevation: where darker areas represent higher elevations.*

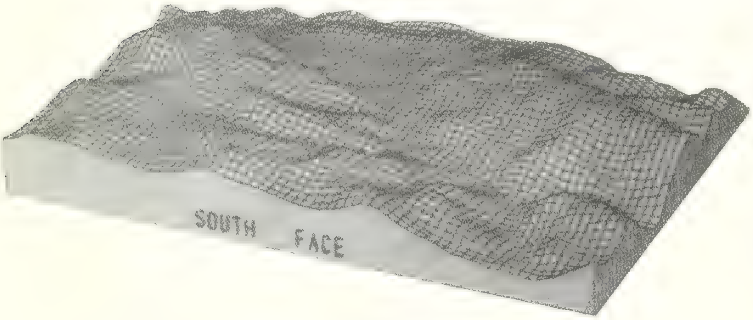

Figure 2.1--*Topographic Surface: where lines represent boundaries of grid cells. (Schock 1978)*

The visual surface pattern map is derived simply by dividing the study area environment into homogenous visual parts. Examples include: trees, meadows, roads, houses, lakes, streams, transmission lines, etc.

Preference testing information in the form of colored slides and prints is collected for each different visual surface pattern feature and/or combination of features in the project study area. In addition, photographs are taken of representative visual features in the region. These regional photographs are used as a standard of comparison for preference determinations in the project study area. Colored photographic simulations are produced to demonstrate the appearance of the proposed physical changes in appropriate locations in the study area. The V.I.S. preference testing procedure[4] (Paulson 1979) insures the use of both public and expert judgments regarding critically important visual quality indices.

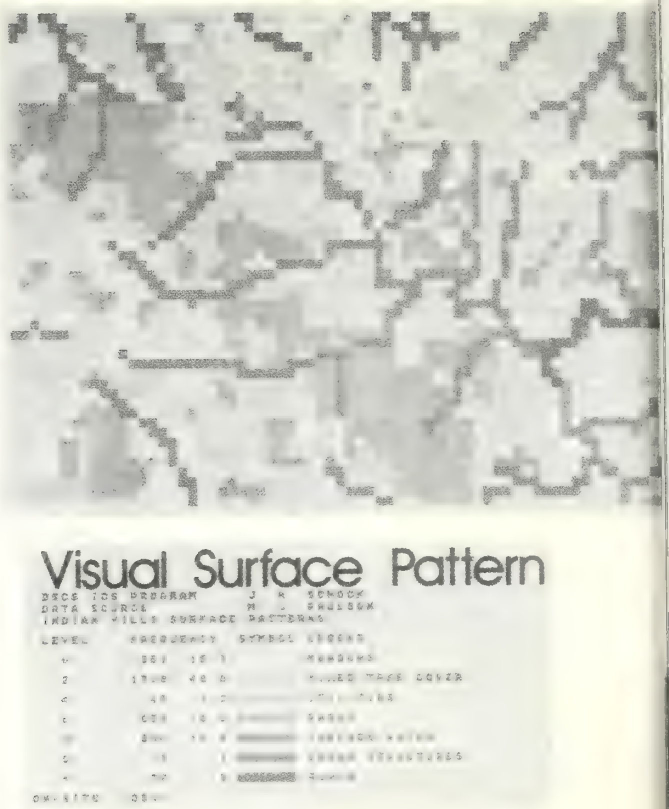

Figure 2.2--*Visual Surface Pattern: where thirty-one visual features are aggregated into six basic visual classes.*

User sensitivity information is developed within the preference testing procedure and applied with visibility and number of viewers data to form the area sensitivity evaluation.

An information verification algorithm entitled "DSCS-DATAVER" (Schock 1978) allows the verification and correction of grid cell maps.

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[4] The preference test procedure was developed in visual quality research conducted through the Landscape Architecture Research Office, Colorado State University, 1975-79.

Phase III: Evaluation

The third phase of the process involves the detailed evaluation of the interrelationships between viewers, the proposed physical changes and the visual environment. Qualitative and quantitative analyses, using computer-aided manual procedures, provide visibility, area sensitivity, duration, view quality, slope, aspect and view impact information in map, photographic, numeric and written form.

The topographic slope and aspect (fig. 2.4 and 2.5) and visual slope and aspect calculation algorithms are entitled "DSCS-SLOPE & ASPECT" (Schock 1978). These algorithms are based upon a unique 'warping' concept which utilizes the four corners, plus the center point, of each cell in the critically important slope and aspect identification procedures.

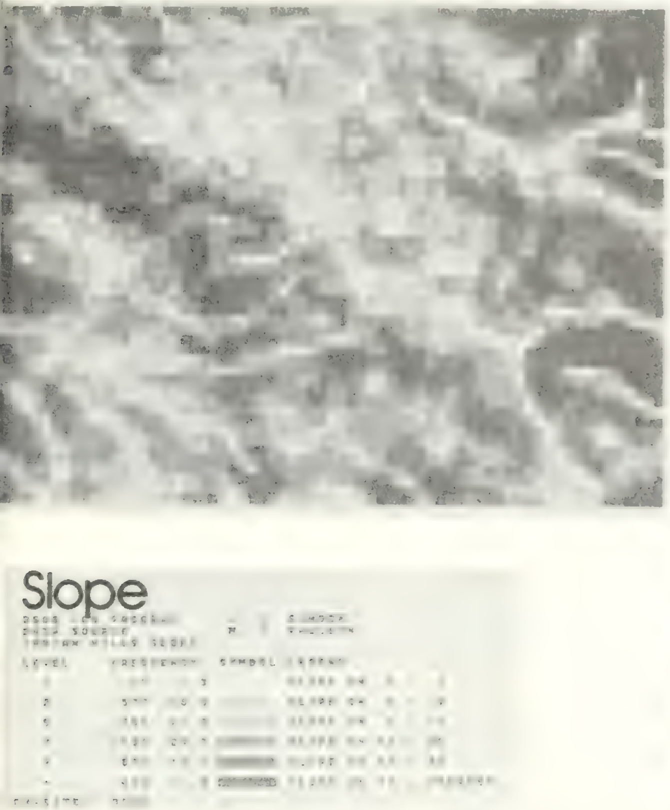
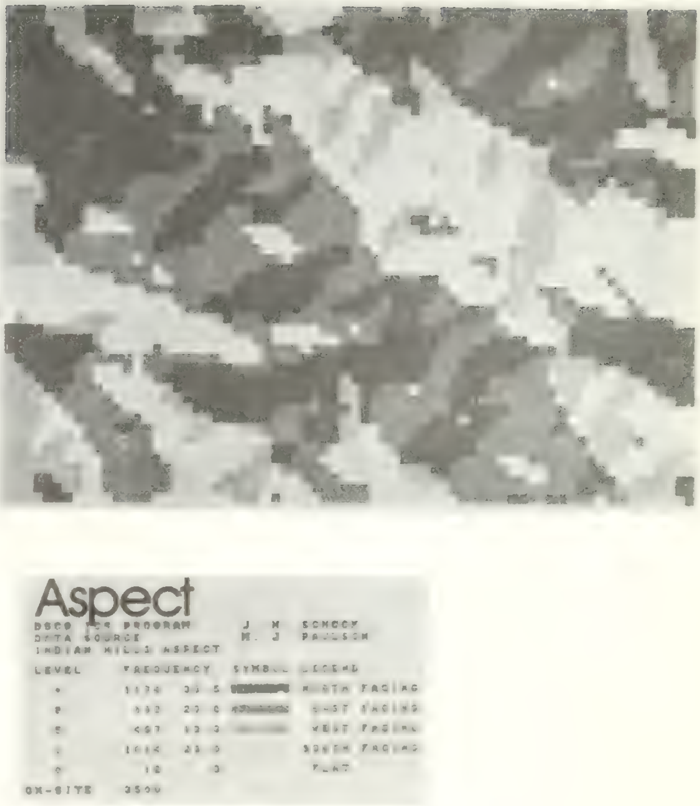


Figure 2.4--*Topographic Slope: where darker areas represent steeper slopes.*

The visibility, sensitivity and quality related analyses are developed with the assistance of the computer algorithms entitled "OCTVIEW & VISQUAL" (Paulson 1978). The author's conception of the visibility algorithm is shown in figures 2.6 and 2.7.



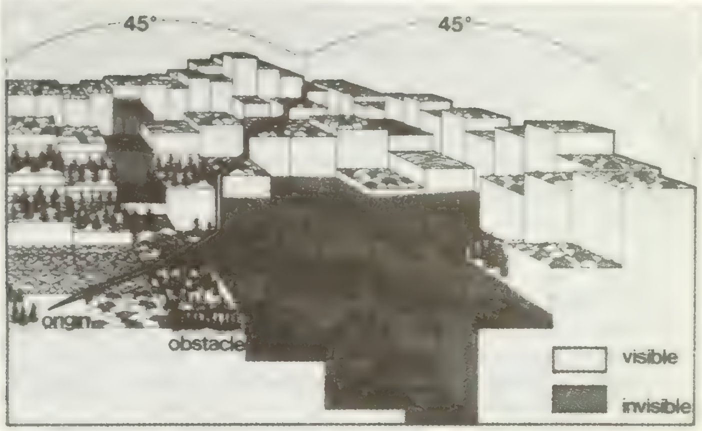


Figure 2.6--*Topography and the Visual Surface Pattern: the three-dimensional concept for the north-northeast and east-northeast views.*

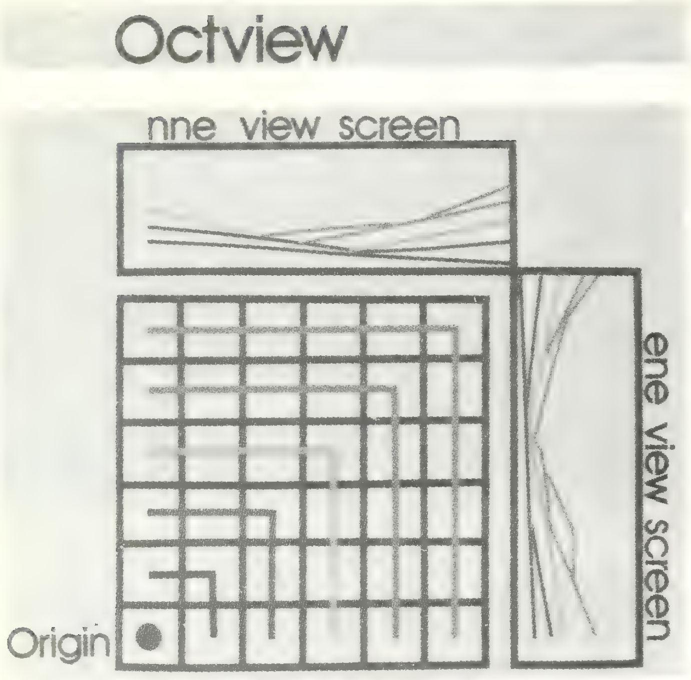


Figure 2.7--*The projection of a theoretical grid pattern upon the north-northeast and east-northeast view screens. Lines visible on the view screens represent visible areas.*

The V.I.S. evaluative capability is particularly useful in providing defensible answers for facility siting studies, environmental assessment studies and mined land visual design studies[5/] (Paulson 1975).

Phase IV: Design and Management

Phase four involves the use of previously derived evaluations and the graphic analysis system[6/] in the development of design criteria, design alternatives and visual management prescriptions at the site scale level. The graphic analysis system utilizes scaled bar charts applied to eye level drawings (fig. 3.0) to identify form, line, color and texture related anomalies in the visual environment.

Phase V: Periodic Review

An important fifth phase of the process is the periodic review of the study area to determine the level of success, and/or possible revisions, of the original designs and management prescriptions. This is accomplished through the application of the graphic analysis system to eye level slides or photographs of the project area.

APPLICABILITY

Experience by many groups in professional work, research and teaching has shown the Visual Information System to be flexible, easy to use, and defensible to the layperson and public. Projects have ranged in scale from 3000 hectares to 140,000 hectares; in complexity from very flat arid deserts to densely vegetated mountainous areas; in viewing distance from 100 meters to 29 kilometers; and in content from mined land reclamation studies, to transmission line siting studies and geothermal energy visual assessments. The V.I.S. computer algorithms have proven to be as accurate for visibility analysis as the most finely tuned topographic and surface pattern data . . . and economicall competitive (Paulson 1978).

TIME AND EXPENSE

The levels of time and expense required to use V.I.S. are directly dependent upon the segments of the system which are employed, and the size and complexity of the project. It is thus impossible to portray adequately in this paper absolute time and expense data for every problem. The following information is based upon several professional projects in which various segments of the system were employed.

Project Preparation

The "start-up" time required for projects has been minimized due to the detailed procedures which have been defined for project organization and inventory. For example, a staff of four people can collect, verify and begin to analyze topographic and surface pattern information for 50,000 grid cells in about two weeks.

Barring changes in proposed actions and/or project requirements, the computer can then analyze visibility, view duration, visual absorption, topographic slope and aspect, and visual slope and aspect in an afternoon.

[5/] Several visual studies, conducted by various public and private agencies and groups, have utilized the V.I.S. evaluative capabilities in these and other situations.

[6/] The graphic analysis system was developed for three limestone quarry reclamation and visual design projects near Colorado Springs, Colorado, which were undertaken by MJP ASSOCIATES, INC.

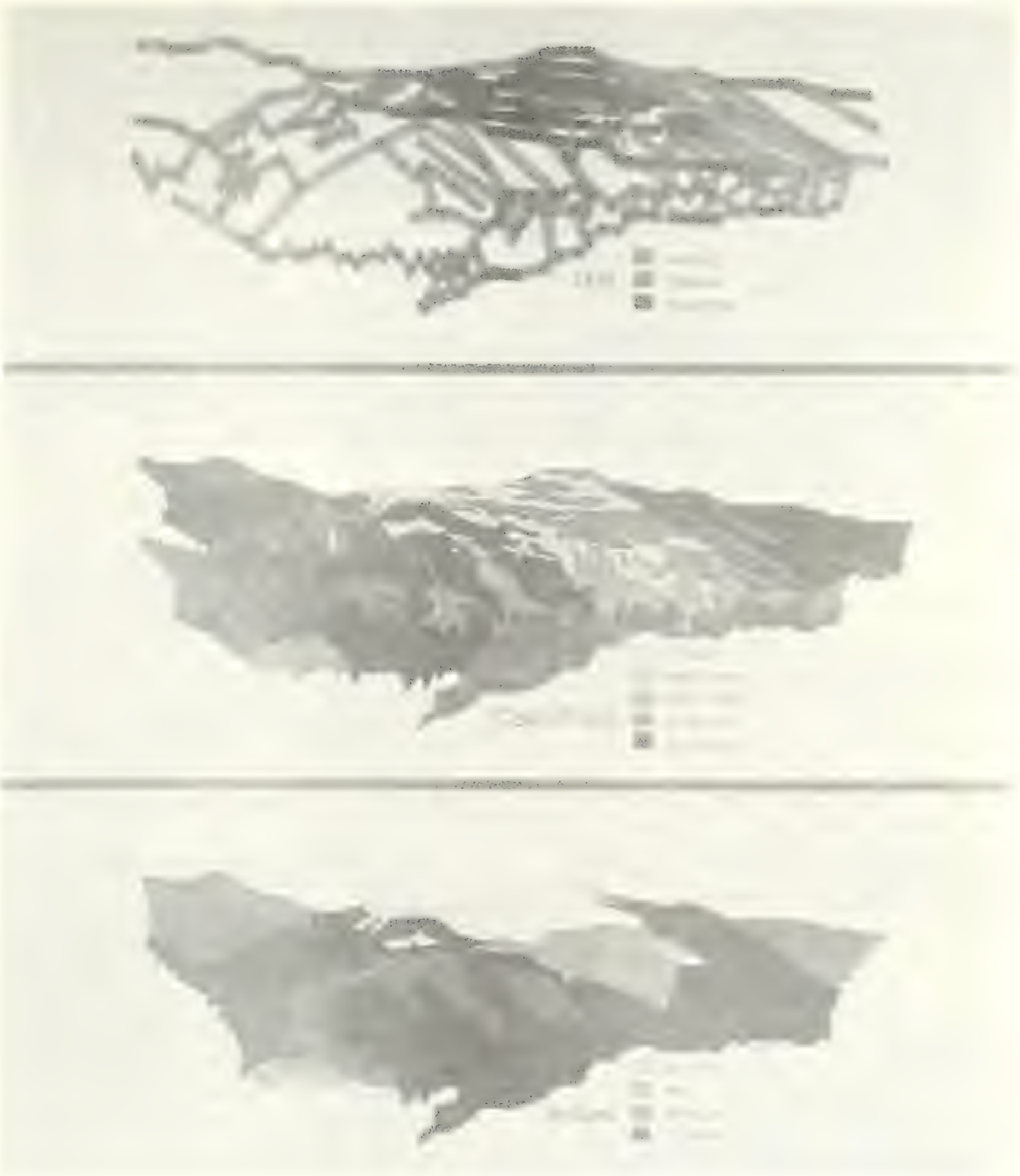


Figure 3.0--*The Graphic Analysis System: values adjacent within the sketches and further apart on the accompanying scaled bar chart represent greater visual contrast and impact.*

Visual quality and visual sensitivity assessments, which depend upon photography and public meetings (time variable), can also be accomplished by the computer in less than a man-day.

Inventory

Manually collected information, such as topography and the visual surface pattern, requires approximately 25 man-seconds per grid cell to inventory for the first project in a study area. Future projects in the same area can use the same topographic information and usually only minimally changed visual surface pattern information at a very small fraction of the original cost. The 25 man-second figure typically decreases for larger study areas (approximately 100,000 grid cells) and increases for smaller study areas (approximately 10,000 grid cells).

Inventory and verification costs for topography are typically $.035 per grid cell for rugged mountain areas and $.02 per grid cell for flat to gently rolling terrain. Inventory and verification costs for the visual surface pattern are typically $.025 per grid cell for complex land use and landscapes, and $.015 per grid cell for homogenous surface patterns.

Slope and Aspect

Computing costs for topographic slope and aspect determinations are $1.50 for the entire map for an approximately 37,000 grid cell area. Computing costs for visual slope and aspect (and a resultant combination) are approximately $.20 each per view origin, depending upon the amount of countryside seen, e.g., it is more expensive when more territory is visible.

Visibility and View Quality

Computing costs for visibility and view quality determinations vary from approximately $.10 per view origin for up to 7 kilometer potential view distances, to approximately $1.20 for up to 29 kilometer potential view distances. These figures are higher if every last grid cell is seen and lower if only a few grid cells are seen, e.g., a person travelling through open rolling terrain will see more grid cells than a person travelling through densely vegetated forests and flat terrain.

Mapping

Computing costs for mapping previously computed information vary with the number of grid cells in the study area and the type of graphics desired by the user. A typical 6, 8 or 10 grid cells per vertical inch, line print map, costs approximately $1.50 for 10,000 cell study areas. A newer gray shaded (looks like zip-a-tone and always comes out report sized) dot matrix map produced by an electrostatic printer/plotter costs 30-50% more for the same sized study areas. A newer yet color/shaded (four colors--five shades of each) map sandwich, produced first in separates, and then in a layer of color for each separate, costs slightly less than five times more than a gray shaded map.

Preference Testing

Public and expert preference testing costs vary with the level of complexity of the project, the number and extent of the proposed actions, and the number of visual surface pattern features and combinations in the project study area. Labor and materials costs for the colored photographic simulations are approximately $10.00 per simulation. Other preference testing costs depend upon travel and man-hour considerations.

Previously mentioned time and expense data relate to specific segments and tasks within V.I.S. Experience has shown that overall times and expenses (specific tasks plus project management) are appropriate and reasonable for public agencies and private land utilization companies who have proposed actions in study areas in which visual issues are deemed critical.

CONCLUSION

It is clear that visual quality analysis and design processes must continue to improve to keep pace with the increasingly rigorous requirements for flexibility, accuracy (defensibility) and cost. It is similarly clear that the greatest opportunity for advancement centers upon a holistic merger of improved technology and the visual design arts. Perhaps the Visual Information System will play a role in the future accomplishment of this necessary merger.

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Visual Management Support System[1]

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Abstract: The Visual Management Support System (VMSS) is an extension of an existing computer program called VIEWIT, which has been extensively used by the U. S. Forest Service. The capabilities of this program lie in the rapid manipulation of large amounts of data, specifically operating as a tool to overlay or merge one set of data with another. VMSS was conceived to computerize map overlaying tasks of the Visual Management System. It is also useful for any project that requires interaction of one or more maps to result in an output map expressing evaluation or interpretation information. VMSS inputs may be from maps or data files that are not landbase associated. This paper deals with VMSS as a tool in visual resource management data manipulation, and explores the application of VMSS on the Klamath National Forest. Sample overlay processes, sample runstreams, problems in implementation and the strengths of VMSS are discussed.

INTRODUCTION TO VMSS

VMSS, a small, fairly specialized grid type computer program, is intended to support the U. S. Forest Service Visual Management System, and is capable of reading one or two input data files. For example, input files may contain information about scenic quality, visible areas, distance zones, visual absorption capability, demographic data, and so on. With one input file, the file can be transformed into a second file (Fig. 1). With two files, they can be merged, or overlayed, to make a third file (Fig. 2). This new file can be printed as an alpha-numeric map, printed as a gray scale (overprinted) map and/or saved on an output file. An acreage table can also be printed as an output.

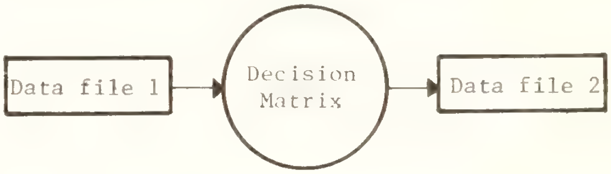

Figure 1--The "transform" option of VMSS allows data (File 1) to be simply relabeled or sorted into groups as specified by the decision matrix. File 2 is the resulting output of the transform process.

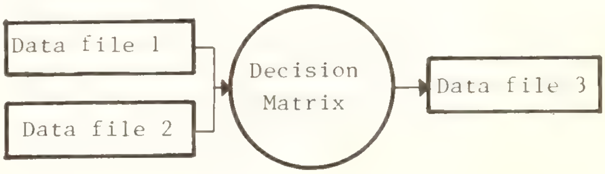

Figure 2--The "merge" process of VMSS interfaces data files 1 and 2 according to the specifications of the decision matrix.

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[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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BACKGROUND

During the last decade, the public has demanded a variety of amenity values from the National Forests, as well as a supply of products such as timber and range. As a result, scenery is now a recognized resource in these forests, and is presently managed under the Forest Service Visual Management System that was established in 1974. The Visual Management System establishes methods for inventorying and mapping variety classes and sensitivity levels and determining visual quality objectives. Visual quality objectives express the relative importance of visual resources in the National Forests based on the land's intrinsic scenic quality (variety classes) and its sensitivity to public viewing pressures (sensitivity levels). The development of visual quality objectives is just the first step in visual resource management. Land managers must also appreciate how difficult, or easy, it may be to achieve those objectives on different units of land.

Visual absorption capability (VAC) establishes a methodology to determine the feasibility of meeting the visual quality objectives. VAC is an analytical process which identifies the landscape's susceptibility to visual change and measures the land's ability to absorb alteration while retaining its visual integrity.

The end product of the visual resource analysis is a map of visual management classes (VMC) and guidelines for visual resource management. A VMC map consists of a discrete visual objective, distance zone(s) and visual absorption capability rating (fig. 3). Visual manag ment classes stratify landscapes in a continuu from visually vulnerable to visually tolerant. The most visually vulnerable landscape is "retention-foreground with a low VAC"; the mos tolerant landscape is "maximum modification seldom seen with a high VAC."

NEED FOR VMSS

After 1974, landscape architects on the 17 National Forests in California began a process of inventorying and mapping variety classes, user sensitivity, visible areas, distance zones, and visual quality objectives following the procedures outlined in Agricultu Handbook 462.

It soon became obvious, however, that it was a very difficult and time-consuming task to map seen areas accurately by hand. A computer program which analyzes seen areas based on digitized topographic data was instituted on several National Forests to aid in the mapping process. This program, called VIEWIT, is a computerized technique of delineating the terrain visible from one or more points (see User's Guide, USDA Forest Service General Technical Report PSW-11/1975). These seen area maps were manually combined with variety class maps to produce visual quality objective (VQO) maps (fig. 4). This manual overlaying was very time consuming.

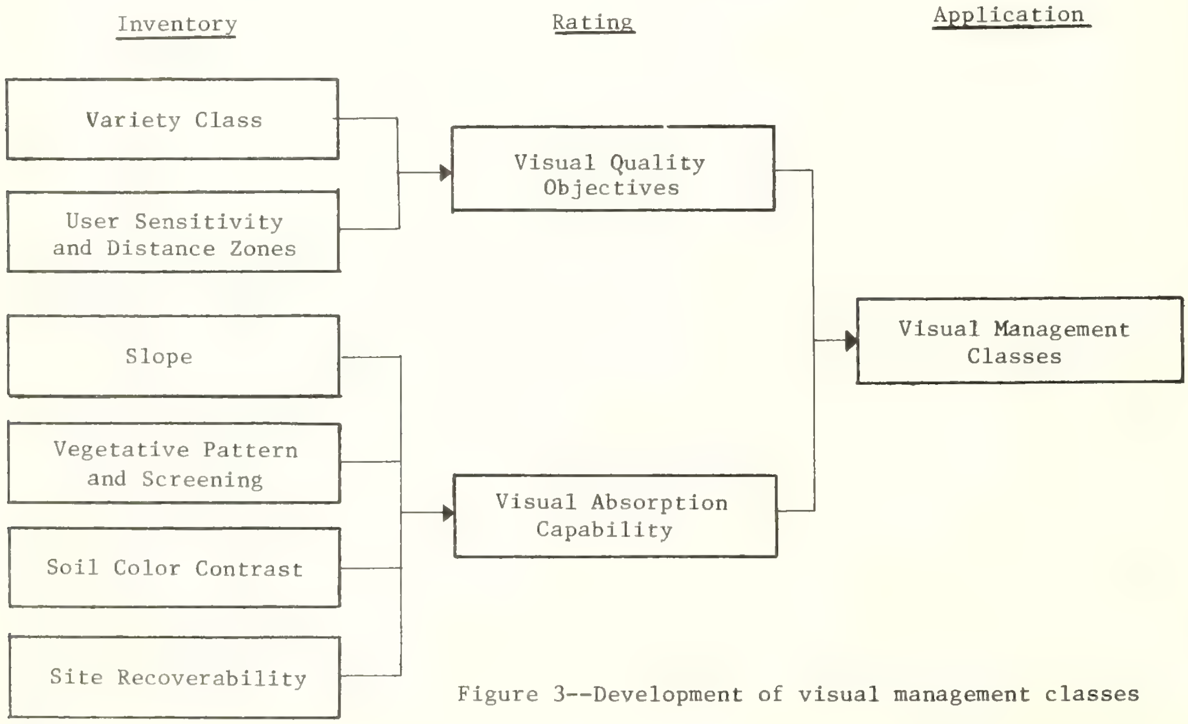
Inventory
Rating
Application
Variety Class
User Sensitivity and Distance Zones
Visual Quality Objectives
Slope
Vegetative Pattern and Screening
Soil Color Contrast
Site Recoverability
Visual Absorption Capability
Visual Management Classes

Figure 3--Development of visual management classes

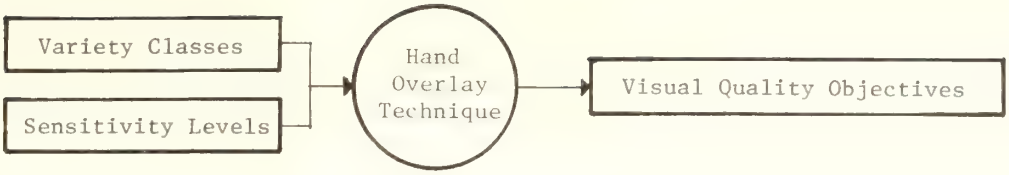

Figure 4

This approach was a tedious process which required many hundreds of hours working over a light table to prepare VQO maps. During this same time, several breakthroughs occurred which expanded the usefulness of VIEWIT. These included a distance and sensitivity level weighting of the seen area maps, and a gray scale map to display outputs graphically. These refinements in the VIEWIT program further emphasized the need to computerize fully the visual management system, including the VQO, the VAC, and the VMC processes. Several Region 5 landscape architects as well as personnel from the Pacific Southwest Forest and Range Experiment Station met and discussed the need to develop such a system. Subsequently, the Visual Management Support System (VMSS) was developed to respond to this need.

KLAMATH NATIONAL FOREST APPLICATION OF VMSS

The Klamath National Forest is located in Northern California and Southern Oregon on approximately 1.7 million acres of land. Its lands are among the steepest, most rugged, and remote in California. These characteristics prompted us to explore various methods of visual resource mapping. One alternative was to map seen areas and variety class completely in the field. Another alternative was to calculate seen areas by plotting topographic cross-sections in the office. Because of the complex and remote land base, however, it soon became obvious that such approaches were both impractical and costly. Therefore, the selected alternative was to digitize topographic data from the Defense Mapping Agency Tapes and utilize VIEWIT to compute seen areas and distance zones. Variety classes were mapped from aerial photographs and then field verified. VMSS was formulated and implemented to combine seen areas, distance zones, and variety classes to make a VQO map. It soon became apparent that VMSS had other applications such as producing VAC maps from ecological land units and VMC maps from VQO and VAC data.

VMSS was designed to be compatible and supplemental to the VIEWIT computer program. As such, it is necessary to explain some of the basic attributes of the VIEWIT program as applied on the Klamath National Forest.

VIEWIT uses a rectangular grid cell which is 1/5-inch wide and 1/6-inch high. This cell size accommodates two alpha/numeric characters per cell. The digitized terrain data base can be overlayed by a topographic map. The map scale ratio we selected was 1:24,000 and therefore each cell is 3.06 acres in size. Different map scales are possible depending on how the terrain data are digitized. Outputs which are possible from the VIEWIT program include seen area maps from one or more observer positions, slope maps, aspect maps, elevation maps, aspect relative to observer maps, slope relative to observer maps, profiles, and acreage tables. Some of the outputs, such as seen area distance zone maps, can be printed either as a numeric map or a gray scale map.

On the Klamath, we utilized VIEWIT to map seen areas from visually sensitive roads, rivers, and use areas. These seen areas were stratified into distance zones of foreground (0 to 3/8 mile), middleground (3/8 to 4 miles), and background (4 miles plus). The output was a gray scale map of seen area/distance zones.

Subsequently, variety class was digitized at the same scale and cell size as the digitized terrain data. Variety classes were mapped as polygons and converted to 1/5 x 1/6 inch grids by the VMSS Digitizer Support System (DGRID). The computerized seen area/distance zone and variety class data were then merged as defined by the decision matrix (page 43 of Agriculture Handbook 462), to create visual quality objective-distance zone maps. These quality objective-distance zone maps were stored in a data file to allow us to combine them with VAC data to create visual management class maps using VMSS.

In the merge example (fig. 5), file 1 is the output file from the VIEWIT seen area analysis. A gray scale map is produced from

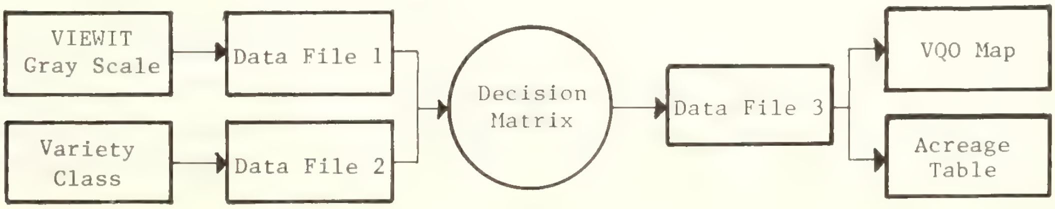

Figure 5

the data before they are stored in file 1. This gray scale map serves as a graphic display of sensitivity levels and distance zones so we can check the accuracy of the VIEWIT run.

File 2 is produced by the VMSS Digitizer Support System from maps of variety class polygon areas. The Digitizer Support System (DGRID) converts these polygons to the same grid as used in VIEWIT (1/5" x 1/6"). The VMSS program then passes files 1 and 2 through a decision matrix which instructs a value in file 1 to be combined with a value in file 2 which then becomes a new value in file 3. The VQO matrix on page 43 of Agriculture Handbook 462 is the decision matrix. File 3 is then printed as a map and an acreage table.

Another use of VMSS is the combination of two VIEWIT seen area maps of the same land to make a "highest sensitivity level" map (fig. 6).

VMSS can also transform the labels on file 1 to a new label on output file 2 (fig.

VMC MAP PREPARATION

To prepare a visual management class (VMC) map using VMSS, the following 3-step procedure would be used (figs. 8, 9, 10).

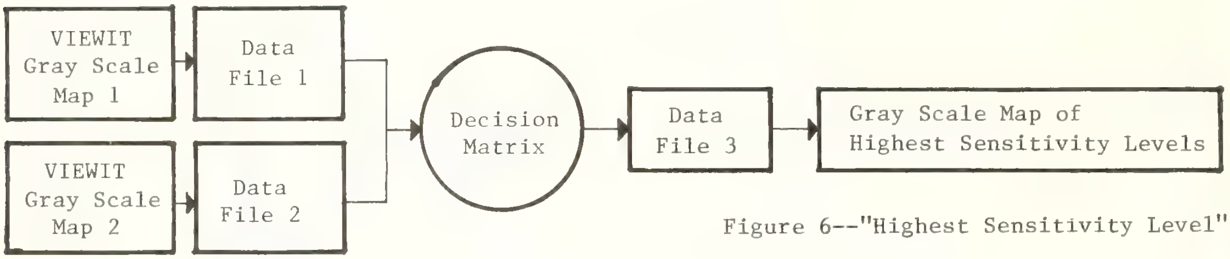

Figure 6--"Highest Sensitivity Level" Map

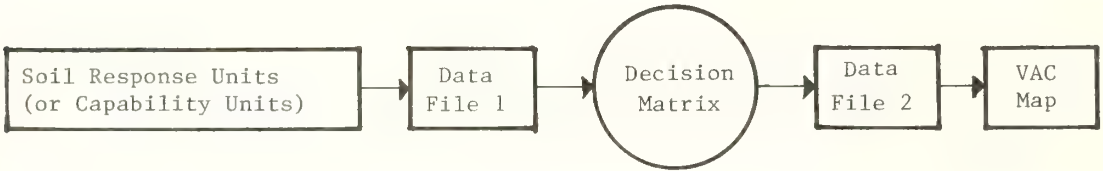

Figure 7--VAC Map

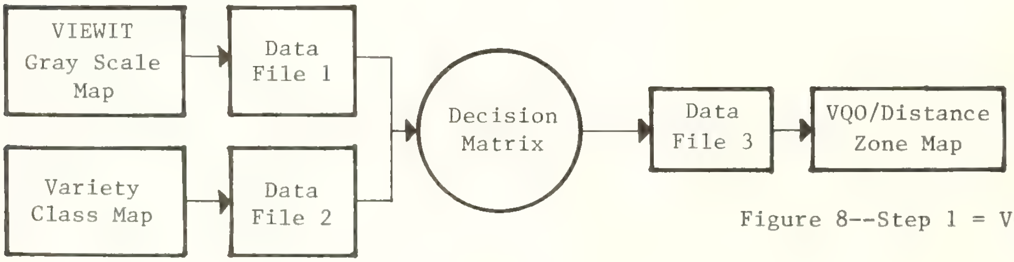

Figure 8--Step 1 = VQO Map

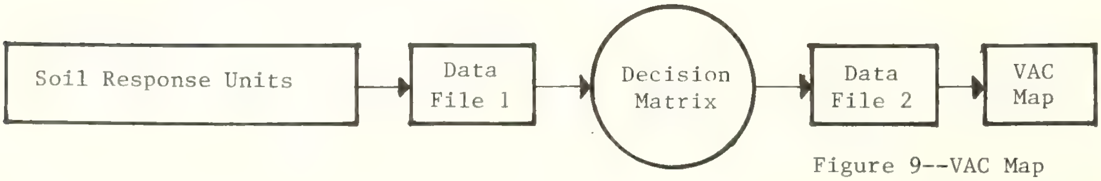

Figure 9--VAC Map

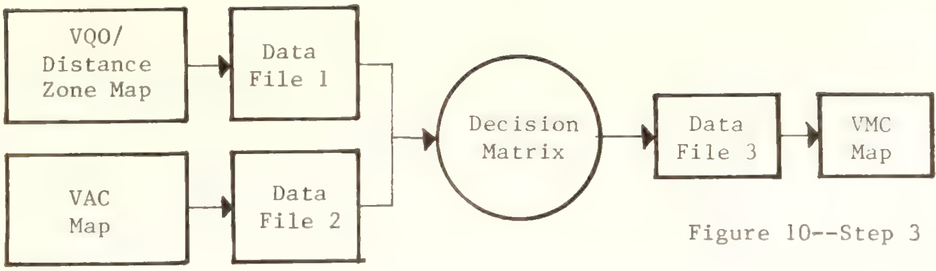

Figure 10--Step 3 = VMC Map

HARDWARE REQUIRED

VMSS requires access to a large memory computer, a digitizer, an intelligent terminal, a high-speed line printer, a data storage system, and a modem. The Klamath National Forest has telephone access to the USDA's Univac 1100-42 computer at Fort Collins, Colorado. On the Forest, there is a Numonics digitizer with a 24" x 24" working area, set up to communicate with an ICL intelligent terminal. The printer is a high-speed ICL 1556. The minimum hardware required to run VMSS is a digitizer, intelligent terminal, high-speed printer, and a modem.

SAMPLE RUNSTREAMS

To prepare a VQO map from an existing file with VIEWIT seen area/distance zone data and another existing file with digitized variety class data, the following runstream would be used. The VIEWIT data are called element "G617" in the file "SENSITIVITY." The variety class data are called element "H7" in the file "VAR-CLASS." See lines 10 and 14 of the following sample runstream. The decision matrix (lines 29-36) specifies the labels to be used in file 3 as a result of each possible combination in the overlay process.

SAMPLE RUNSTREAM FOR USE AT FORT COLLINS COMPUTER CENTER

```
 @RUN . . .
        Standard runcard format
1:@SYM PRINT$,,FCR051
        This line identifies our site I.D.
        number.
2:@MSG,N RECOMMENDED VQO FOR H7
        Print the following message at the
        beginning of the computer printout.
3:@ASG,A PSW*VIEWIT
        Assign the VIEWIT program.
4:@ASG, AX SENSITIVITY.
        Assign the previously cataloged file
        SENSITIVITY, and give this run exclu-
        sive use of the file.
5:@ASG, A VAR-CLASS.
        Assign the previously cataloged file
        VAR-CLASS.
 6:@ASG,T T1
          Assign a temporary file called "T1."
 7:@ASG,T T2
          Assign a temporary file called "T2."
 8:ASG,T T3
          Assign a temporary file called "T3."
 9:@DATA, I T1.
          Add the following data to T1, initial
          insertion, previous data in the file
          will be written over.
10:@ADD,D SENSITIVITY.G617
          Add element G617 from the file
          SENSITIVITY to T1.
11:@END
          End of data insertion.
12:@FREE SENSITIVITY
          Free file for use by other runs.
13:@DATA,I T2.
          Add the following data to "T2."
14:@ADD,D VAR-CLASS.H7
          Add the element "H7" from the file
          "VAR-CLASS" to file "T2."
15:@END
          End of data insertion.
16:@XQT PSW*VIEWIT.VMERGE
          Run the VMERGE (VMSS) process of the
          VIEWIT program.
17:TITLE ='RECOMMENDED VQO FOR H7'.
          Title printed on top of each page of
          output.
18:REMARK = 'FILE 1 IS SENS.LEVEL FROM VIEWIT'.
          Remarks for user's information only,
          not used in run.
19:FILE (1): NAME ='T1'.
          Begin definition for file "T1."
20:NCOLS=240,NROWS=432.
          Number of rows (NROWS) and columns
          (NCOLS)
21:XOFF =120,YOFF =144.
          Defines by row and column lower left
          corner of data sub-rectangle.  See
          fig. 1.  File 1 432 rows high and 240
          columns wide.  The sub-rectangle we
          want is Area B.  The XOFF and YOFF
          define Point C.  The XUSE and YUSE
          define the size of Area B.
```

22:XUSE =120, YUSE =144.
Defines by row and column size of subrectangle to be used in the merge, or overlay, process.

23:SKIT=1.
Skip first record of the file. The first line of this file contains information necessary to define the contents of the file. As this line is not part of the data, it must be skipped. Any number of lines may be skipped to arrive at the first line of data. If the first line in the file were data, this command would be eliminated.

24:INT,FORMAT='(40I2)',LABEL (10)='F1',LABEL (8)='M1",LABEL (6)='B1'.

25:LABEL (5)='F2',LABEL (4)='M2',LABEL (3)='B2', LABEL (0)='@3'/
This line defines the data in file 1 (T1). INT = Integer (whole numbers). FORMAT defines how the file was originally written. The label command allows the user to modify the values for readability. If this were not done, then line 30 would have to read 10,8,6,5,4,3,0.

26:REMARK ='FILE 2 IS VARIETY CLASS'.
Remark (not used by program).

27:FILE (2):NAME ='T2'/
Start definition for file T2. The attributes of file 2 (T2) are contained in the file itself. Therefore, it only needs to be specified, but not defined like we had to define file 1 (T1).

28:REMARK = 'DEFINE TABLE'
Remark (not used by program).

29: TABLE (7,6):
Size of decision matrix is 7 columns by 6 rows of labels.

```
30:         'F1', 'M1', 'B1', 'F2', 'M2', 'B2',
            '@3'/
31:'A':     'RF', 'RM', 'RB', 'LF', 'LM', 'LB',
            'L3'/
32:'A-':    'RF', 'RM', 'RB', 'LF', 'LM', 'LB',
            'L3'/
33:'B':     'RF', 'LM', 'LB', 'LF', 'DM', 'DB',
            '?3'/
34:'B-':    'RF', 'LM', 'LB', 'LF', 'DM', 'DB',
            '?3'/
35:'C':     'LF', 'LM', 'DB', 'DF', 'DM', 'XB',
            'X3'/
36:OTHER:   '  ', '  ', '  ', '  ', '  ', '  ',
            '  ',
```

Values contained in file 2 (T2) SENSITIVITY: also see Lines 24 and 25. Left most values A, A-, B... are values found in File 2 (T2) VAR-CLASS. Intersected values are desired result of overlay to be placed in File 3 (T3) VQO, eg. A + F1 = RF. The "A" means variety class A. "F1" means foreground sensitivity Level 1. "RF" means retention foreground. While variety classes A/A- and B/B- have separate positions in the matrix, the resultant VQO's are not affecte by the "minus" sign. They appear simply because the variety class file has data of a fine detail usefu for other applications but not necessary for VQO determination.

In the body of the table are two-character VQO-distance zone symbols, the first character representing the VQO (R=RETENTION, L=PARTIAL RETENTION, D=MODIFICATION, X=MAXIMUM MODIFICATION, ?=MODIFICATION OR MAXIMUM MODIFICATION depending on VQP's of adjacent land units). The second character of the VQO-distance zone symbol refers to the distance from which the land unit is seen by the most sensitive observer (F=Foreground 0-3/8 miles, M=Middleground 3/8-4 miles, B=Background 4+ miles, and 3=Seldom Seen by Forest Visitors The blank spaces in quotes ...' ', on line 36 refer to sensitivity leve 3 (seldom seen areas) and/or non-National Forest lands which were excluded from VQO distance zone assignment.

37:REMARK = 'COMBINE FILES ONTO SCRATCH FILES'
Remark is for user's information and is not used in program.

38:FILE (3): NAME='T3', NCOLS=120,NROWS=144.
Begin definition for File 3 (T3).

39:FORMAT='(40A2)', SELF LABEL/

40:MERGE,
Merge or overlay maps.

41:REMARK= 'DO OUTPUT OPTIONS', MTITLE='REC VQO H7 ', MAP,ATABLE,SAVE,STOP,
The remark is for the user's information only and is not used by the program and ends at the first comma. MTITLE prints out a block letter, grey scale title at the beginning of the map. The MAP command prints out the actual map, ATABLE produces an acreage table and SAVE creates an output file for other merge runs. The STOP command stops the program, notice it is followed with a comma.

42:@ASG,AX REC-VQO
Assign the file "REC-VQO" and give this runstream exclusive use.

43:@ELT,I REC-VQO.H7
Initial insertion of data into elemen "H7" into file "REC-VQO."

44:@ADD,D T3.
Add output of merge process (temporar file "T3") as element "H7" in file "REC-VQO."

45:@EOF = End of file.

STRENGTHS OF VMSS

Four of the biggest strengths of VMSS are:

1) The ability to computerize a mapping process which is rote (non-creative) with the possibility of making broad changes very quickly. Such changes with short turn-around times will often occur with National Forest land and resource management planning efforts. Visual effects of Forest Service alternative plans or alternatives suggested by the public can be accurately and quickly mapped with VMSS. Such effect predictions would be very difficult and time consuming to prepare accurately by hand.

2) The capability to make a grid map from a polygon map.

3) The ability to combine parts of two maps into a third map.

4) The transferability of VMSS. Although VMSS was originally intended to support only the Visual Management System to make a VQO, VAC, or VMC map, it can also be used to combine soils, vegetation, demographic or other mapped data to prepare virtually any overlaid output map that may be desired. Therefore, disciplines other than landscape architects will become more interested in VMSS as time goes on.

PROBLEMS ENCOUNTERED WITH VMSS

Some of the problems we have encountered with VMSS are:

1) The process of digitizing variety class is subject to human and hardware errors. This has caused us both to re-digitize variety class maps and to "patch" errors in the variety class data file. Other users who have digitized vegetative type maps have experienced the same problem. We would speculate that these problems occur because the digitizer operator goes too fast and creates errors by omitting line segments and labels or by introducing extraneous line segments which create unlabeled polygons. Also, the hardware (Numonics digitizer and ICL terminal) may be responsible for some of the errors.

2) Small polygons create difficulties in digitizing because it is often difficult to enclose these polygons with line segments and then fit a label within them. If the label is located on the same coordinates as a line setment, the label will be ignored, which results in an error.

3) VMSS, like any other batch program, is very literal. If a "comma" is placed in a runstream where a "period" is required, the entire runstream will fail. Also, a certain knowledge of computer "jargon" is required to run any batch program.

4) "Patches" are made in a batch mode. Therefore, if the "corrected" digitized map is not error free, it is difficult to know if original errors were not corrected or if the patches created new errors, or both.

5) It takes a considerable amount of time and effort to digitize successfully. After various data files are successfully digitized, it is very easy to use VMSS to merge repeatedly or transform these files into new files.

CONCLUSION

We think that the payoff of using VMSS will come during the alternative formulation and evaluation stages of land management planning. These evaluations will require rapid manipulation of data for many alternatives.

The Visual Management Support System offers increased accuracy and flexibility in visual resource planning and management. This is accomplished by allowing the user quickly to manipulate data files in the alternative evaluation stages of broad-scale land planning. It also allows the user accurately and quickly to assess visual resource outputs of various land allocation proposals.

A Systematic Approach for Locating Optimum Sites[1]

Angel Ramos and Isabel Otero[2]

Abstract: The basic information collected for landscape planning studies may be given the form of a"s x m"matrix, where s is the number of landscape units and m the number of data gathered for each unit. The problem of finding the optimum location for a given project is translated in the problem of ranking the series of vectors in the matrix which represent landscape units. The paper describes a method to do this, solely on the basis of data gathered.

Landscape planning studies or projects frequently (and with some approaches always) have to face the problem of assigning optimal land uses according to certain objectives; this, of course, implies that a reliable framework, within which decisions can be taken, must be established beforehand.

Planning, nowadays, is multiobjective, even in its most classical forms. The consideration of ecological and visual aspects peculiar to landscape planning reinforces this multiobjectivity, simultaneously introducing further complications. Many objectives inherent in landscape planning are:

a) not commensurable with conventional objectives, nor even with one another.

b) not measurable or, when they are measurable, impossible to value.

The models designed over the last few years to solve this problem have come in for a good deal of criticism based mainly on the subjectivity of the evaluations (e.g., weighting according to the opinion of experts) or on the consideration that any attempt to objectivize something as personal as landscape perception is futile. These criticism may be refuted with the same arguments in that they are totally subjectively bound within a system of measurement which, though hallowed through the ages, is incapable of measuring new factors of undeniable value, whether intrinsic or man-imposed. "The only substitutes for informed value judgments are uninformed value judgments" (Davidson 1967); considered value judgements are based on a knowledge of the facts, not on sentiment, and are, at the very least to be respected.

This paper describes one such line of research carried out in our department the search for methods to rank constitutive or defining elements of landscape and landscape units, according to their intrinsic significance (attractiveness, suitability, carrying capacity, vulnerability, fragility, etc.) or in relation to human activities. Ordinal scales are used, since it is easier to determine and therefore to accept, that one of two given elements makes a greater contribution to visual quality than to quantify that contribution.

DESCRIPTION OF THE METHOD

The aim is to order a series of

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Professor and Graduate student, E.T. S. de Ingenieros de Montes, Universidad Politécnica de Madrid, Spain.

vectors, representing points in the territory, whose coordinates are expressed in non-commensurable terms. The basic idea is to establish and make explicit ordinal relationships with adjustments according to certain criteria or factors conditioning the definition of the problem.

The observations relating to the ecological and landscape variables characterizing the environment usually refer to points on a network or particular territorial units; they may thus be expressed in a matrix:

$$((P)) = \begin{pmatrix} \bar{P}_1 \\ \cdot \\ \cdot \\ \cdot \\ \bar{P}_s \end{pmatrix} = \begin{pmatrix} p_{11} & ----- & p_{1m} \\ \cdot & & \\ \cdot & & \\ \cdot & & \\ p_{s1} & ----- & p_{sm} \end{pmatrix}$$

s = N° of points or territorial units
m = N° of elements defining the landscape

This information, gathered in the preliminary phases of the study, is merely descriptive, nominal and has no direct significance for planning; it must, therefore be made operative. One procedure consists in establishing an ordinal relationship, once each variable j (j=1, 2, ---, m) has been defined and the different j_k types presented by each have been characterized, between the partial descriptions and the values 1, 2, ----, n_j on an ordinal scale, where n_j is the number of values on the ordinal scale with which the element j types have been related.

For instance, let us suppose that the visual vulnerability of landforms is to be considered and that this variable has been divided into three types. The relation, in this case, could be established as follows:

Nominal description	Ordinal scale
p_{j1} = steep slopes	1 (Highest)
p_{j2} = gentle slopes	2
p_{j3} = plain grounds	3 (Lowest)

The matrix ((P)) describing the territory is thus expressed as follows:

$$\begin{pmatrix} \bar{P}_1 \\ \bar{P}_2 \\ \cdot \\ \cdot \\ \bar{P}_2 \end{pmatrix} = \begin{pmatrix} n_{11} & n_{12} & ---- & n_{1m} \\ n_{21} & n_{22} & ---- & n_{2m} \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ n_{s1} & n_{s2} & ---- & n_{sm} \end{pmatrix} = ((n_{ij}))$$

$$i = 1, 2, ----, s$$
$$n_{ij} \varepsilon 1, 2, ----, n_j$$

Definitions

Given two points in the territory:
$A = (n_1, n_2, ---, n_m)$ and
$B = (n'_1, n'_2, ---, n'_m)$
we say that A precedes or is superior to B (A < B) if, and only if, $n_i \leqslant n'_i$, $\forall i = 1, 2, ---, m$.

Thus, A = (1,2,4,4) precedes to B = (2,2,5,6) since 1<2, 2=2, 4<5, 4<6. If $n_i < n'_i$ is not held for every i, as in A = (1,2,4,4) and C = (2,1,3,6), we say there are non-inferior points to each other.

Process

These definitions lead to a first obvious ordination, not sufficient however in most cases because the relation will only work for a few points. But the process may continue by calculating the number of points each precedes and is preceded by, and a new order may be established between the columns of the matrix, i.e., between the points in the territory.

A more general view is obtained if, instead of starting from the matrix $((n_{ij}))$, whose dimensions are s x m, another is considered which contains all theoretically possible cases, its dimensions being, therefore, n^m x m for a territory described by m elements each divided into n types. The real case may thus be considered a sub-set of the complete set of all possible cases and this sub-set may in turn be compared with the case considered in isolation.

Let a point $A=(n_1, n_2, ---, n_j, ---, n_m)$ in the theoretical general matrix containing the data: $n_j \varepsilon 1,2,---,n$.

If we consider only the first column of A, each point whose first element is lower than or equal to n_1, precedes A. By analogy, all points whose j column is occupied by values lesser than or equal to n_j will precede A. Consequently, if equality is included among the precedences, the total number of compositions preceding A will be given by:

$$N_1 = n_1 x n_2 x --- x\ n_j\ x --- n_m = \prod_{j=1}^{j=m} n_j$$

Similarly, the points preceded by A will be all those whose j column is occupied by values higher than or equal to n_j, $\forall_j$. If, in this case, equality is also included in the precedences, the number of compositions preceded by A will be

$$N_2=(n+1-n_1)(n+1-n_2)--(n+1-n_m)=\prod_{j=1}^{j=m}(n+1-n_j)$$

So, by calculating N_1 and N_2, a set of vectors with m coordinates $(n_1, n_2, ---, n_m)$ is exchanged for another set of vectors with two coordinates (N_1, N_2), which are easier to order.

Now, a point $A = (N_1, N_2)$ will be superior to or will precede another point, $B = (N_1', N_2')$ if, and only if,

$$\left\{\begin{array}{l} N_1 < N_1' \\ N_2 \geqslant N_2' \end{array}\right. \quad \text{or} \quad \left\{\begin{array}{l} N_1 \leqslant N_2' \\ N_2 > N_2' \end{array}\right.$$

If the relation existing between A and B is:

$$\left\{\begin{array}{l} N_1 > N_1' \\ N_2 > N_2' \end{array}\right. \quad \text{or} \quad \left\{\begin{array}{l} N_1 < N_1' \\ N_2 < N_2' \end{array}\right.$$

we shall say that A and B are non-inferior to each other.

Coming back to the example of points A = (1,2,4,4) and C = (2,1,3,6), in wich we now put n=6:

$N_{1A}=1x2x4x4=32$ $\quad N_{2A}=6x5x3x3=270$

$N_{1C}=2x1x3x6=36$ $\quad N_{2C}=5x6x4x1=120$

$$N_{1A} < N_{1C}, \quad N_{2A} > N_{2C}, \quad A < C$$

Therefore, points A and C, initially non-inferior, become ordinated in the first calculation of precedences: A precedes to C.

The simple structure of the general theoretical matrix, makes it possible to construct a "tree" to reflect an initial order of points (fig. 1). By calculating the precedences, the set of vectors with two coordinates (N_1, N_2) is obtained. These coordinates may also be arranged on a "tree" with a more clearly defined structure, again allowing the number of points preceding and preceded by each to be counted (fig.2). Thus, by repeating the process, the existing non-inferiorities will be resolved until the total order is obtained, at which point no further counts will be necessary (fig. 3).

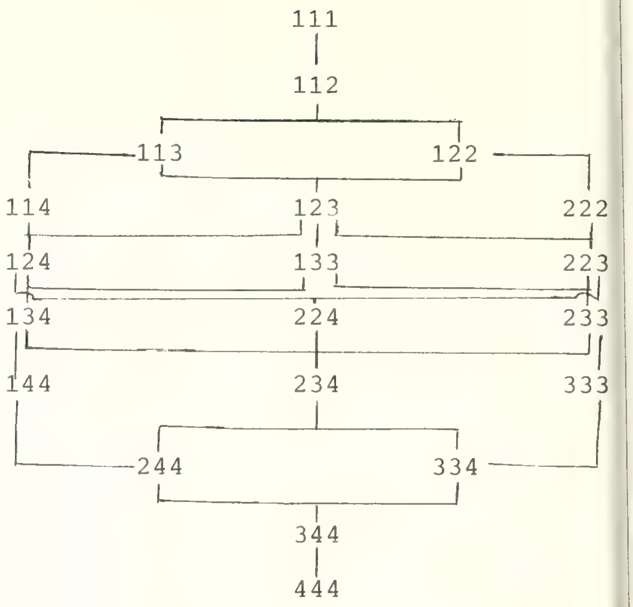

Figure 1--Initial tree, for m=3, n=4. Only the different combinations are used.

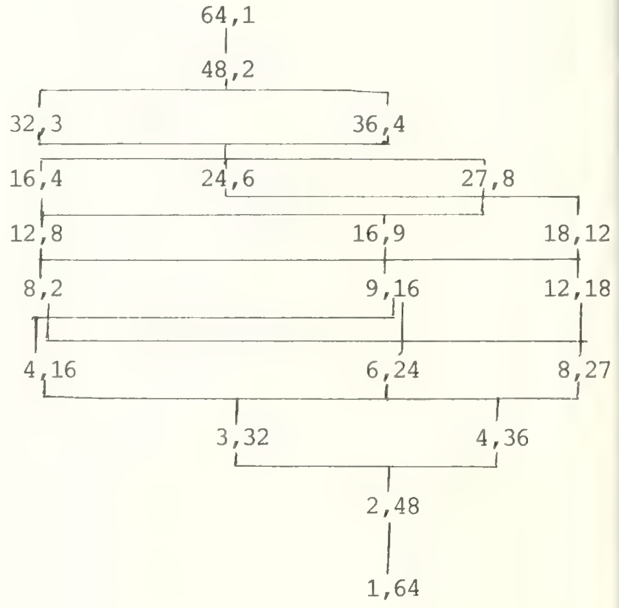

Figure 2--Tree of precedences, first iteration Calculations are made on the number of variations.

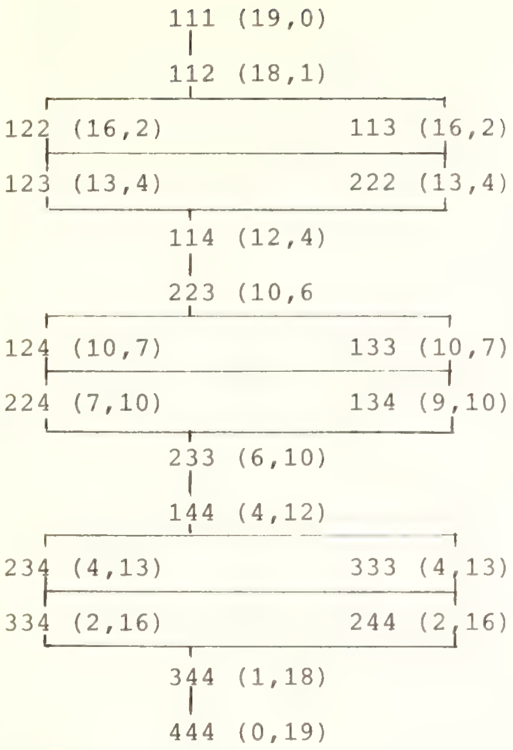

Figure 3--Tree of precedences, second iteration. Final result.

GENERAL ALGORITHM

Given m and n:

- Make $\binom{n+m-1}{n}$ possible combinations of $(n_1, n_2, ---, n_m)$
- Calculate for each:

$$N_1 = \prod_{j=1}^{j=m} n_j$$

$$N_2 = \prod_{j=1}^{j=m} (n+1-n_j)$$

- Establish order relationships

$$A=(N_1, N_2) < B=(N_1', N_2')$$

if, and only if,

$$\begin{cases} N_1 < N_1' \\ N_2 \geqslant N_2' \end{cases} \text{or} \quad \begin{cases} N_1 \leqslant N_1' \\ N_2 > N_2' \end{cases}$$

$$A=(N_1, N_2) > B=(N_1', N_2')$$

if, and only if,

$$\begin{cases} N_1 > N_1' \\ N_2 \leqslant N_2' \end{cases} \text{or} \quad \begin{cases} N_1 \geqslant N_1' \\ N_2 < N_2' \end{cases}$$

- Calculate, for each point, the number of combinations preceding it, N_3, and the number preceded by it, N_4.

-Repeat the process with the new values (N_3, N_4).

-Make successive repeats until no further ordering is possible.

-Tabulate the final order, indicating the combinations corresponding to each level.

Comments

The algorithm is based on the formation of combinations rather than variations; thus, for example, the point (1,1,2,2,) is not differentiated from the point (1,2,1,2). This is only possible if each element considered descriptive of the landscape is divided into an equal number of classes, since, in this case, all the variations derived from the same combination will have the same (N_1, N_2) values and will consequently be situated on the same level.

Calculations are made on the total number of variations, although only the distinct combinations are used. When the number of descriptive elements -m- is high, this simplification becomes necessary, as the number of possible variations is several orders of magnitude greater than the number of combinations and the excessive volume of data would render the system inoperative. Thus, for example, in a fairly common case, 10 descriptive elements divided into 6 classes (m=10, n=6) might be considered; the number of possible combinations would be $\binom{10+6-1}{10}=\binom{15}{10}=3003$, and the number of variations somewhat over 6×10^7.

When $n_1 \neq n_2 \neq .... \neq n_m$ (n_j is the number of classes into which each element j is divided), the values of N_1 and N_2 will be:

$$N_1 = \prod_{j=1}^{j=m} h_j$$

$$N_2 = \prod_{j=1}^{j=m} (n_j+1-h_j)$$

for a point $(h_1, h_2, ---, h_m)$

Once these values have been deduced the process continues exactly as is the case where $n_1=n_2=...=n_m$.

If the points are ordered taking all possible combinations into account, classifications from two different territories may be compared, since the levels will have the same meaning in both. There will, however, be no equivalence between levels of two trees based on real data.

If a project has to be made for a given territory, it may be more practical to consider real units for, in this case, the order will more faithfully reflect the characteristics of the area, in that the best points will appear at the first level, even though they may not be of excellent quality.

Nevertheless, the structure of the territory under study may be better understood if the real data are situated in a more general framework. Moreover, if only slight differentiation is required, all points being grouped in a small number of classes, it may be advisable to deduce the classification from the total number of possible combinations and, subsequently, place the combinations occurring in reality at the appropriate level.

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The Use of VIEWIT and Perspective Plot to Assist in Determining the Landscape's Visual Absorption Capability[1]

Wayne Tlusty[2]

Abstract: The concept of Visual Absorption Capability (VAC) is widely used by Forest Service Landscape Architects. The use of computer generated graphics can aid in combining times an area is seen, distance from observer and land aspect relative viewer; to determine visual magnitude. Perspective Plot allows both fast and inexpensive graphic analysis of VAC allocations, for project use.

HISTORY

The concept of using visual abosrption criteria to assess the relative ability of landscapes to absorb development, by type and level, was first documented in 1968 (Jacobs et al.1968). The Visual Absorption Capability (VAC) concept was developed in 1971 by the Forest Service in the Alaska Region (Knode). The Forest Service Manual defines VAC as, the relative ability of a landscape to accept management manipulations, without significantly affecting its visual character.

Initial VAC studies were conducted primarily in the western regions of the Forest Service. The Mineral King Visual Analysis (Johnson et al. 1974), used the concept of ability to absorb visual modification to predict the effects of four transportation system alternatives on existing visual quality. A significant development during the Mineral King study, allowed the concept of visual magnitude to be incorporated into the computer program of VIEWIT (Elsner et al. 1975). When both viewed distance, land aspect relative to observer, and times an area is seen are combined by computer programming, they produce a numeric, or gray shade map, of visual magnitude.

A study on visual vulnerability (Litton 1974) addressed the characteristics of landscape compositional types, sensitive parts and locations, and outside influences and effects which are helpful in predicting visual impacts. A 1976 study (Anderson et al.1976), documented the concepts of bringing visual quality objectives and VAC mapping together. A pilot study in the development of a VAC assessment procedure for the State of Massachusetts (Williamson 1977) states that over sixty variables are being used to explain the relative differences in the landscape's ability to absorb visual impacts.

The Forest Service manual presently addresses the weighting of factors, i.e., slope, landscape complexity, soil color, vegetative screening. The factors are combined to establish maps of high, intermediate and low absorptive capacities. This current VAC process generally involves a matrix display of the more significant local variables which are generally intuitively weighted and then mapped. These maps are used to predict how difficult it will be to meet a visual objective, determine relative costs, determine where best to place developments and establish priorities for landscape architect involvement.

CASE STUDY

A VAC study (Hilliard et al. 1977) conducted on the Kootenai National Forest used a process somewhat similar to the current Forest Service Manual format. The study area was about 5,000 acres and located in northwestern Montana. The majority of the area had a visual quality objective of partial retention. The area was viewed from a major reservoir, state highway and a forest development road. Six of the most

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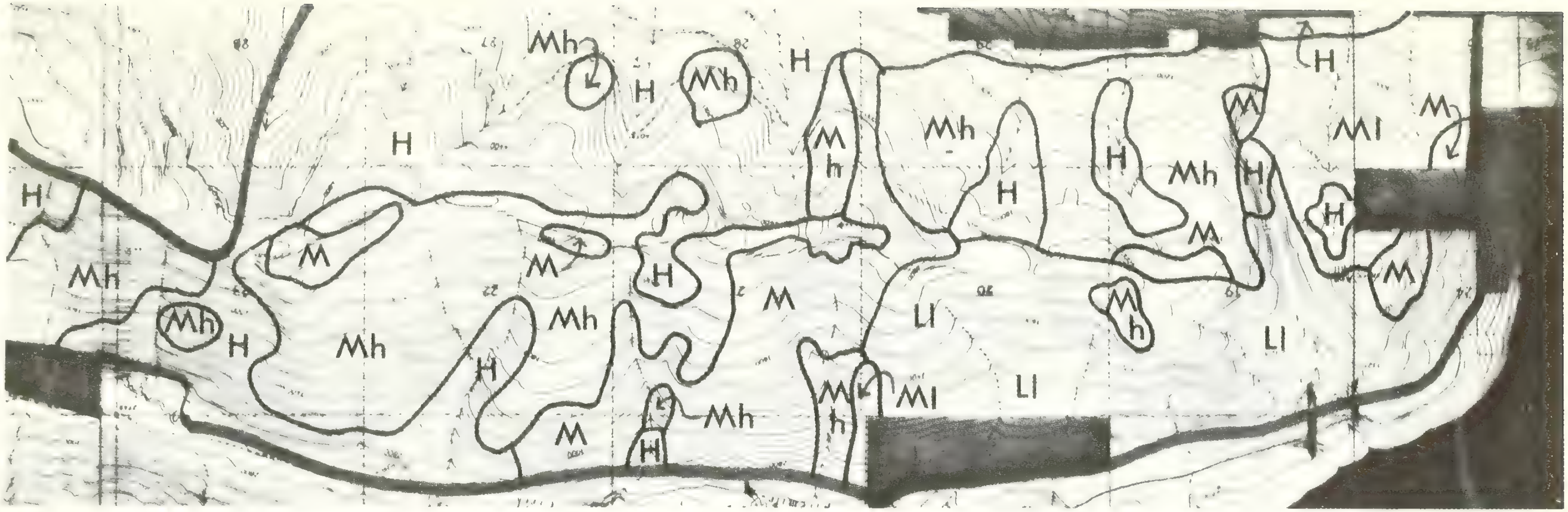

Figure 1.--VAC mapping of the study area with a scale of Ll (low ability to absorb clearcuts), Ml (moderately low), M (moderate), Mh (moderately high), and H (high) which displays the relative ability to absorb impacts as viewed from significant viewpoints.

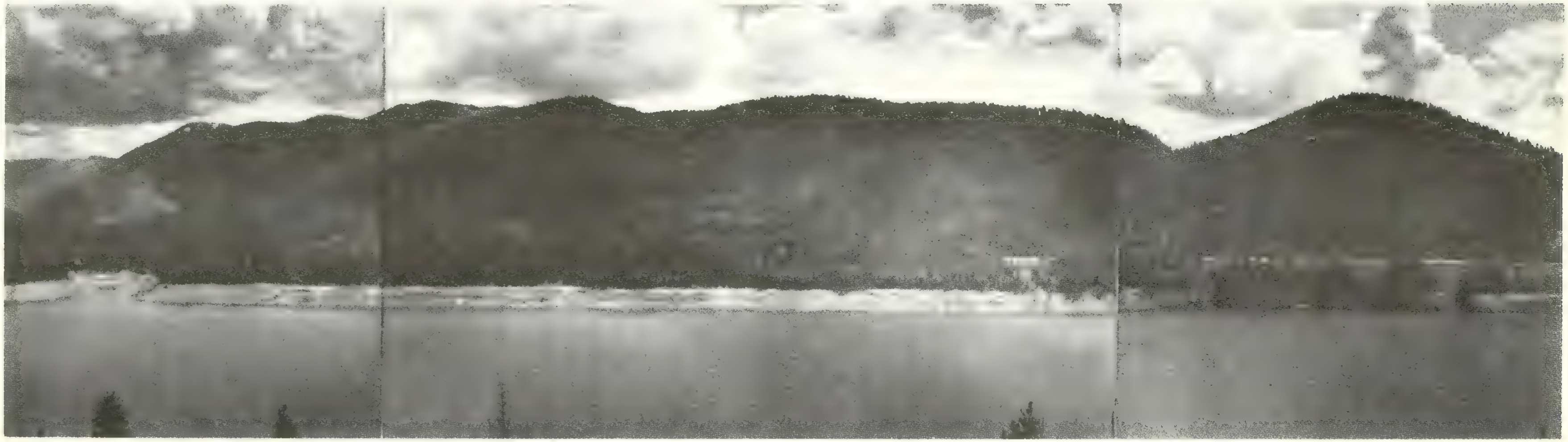

Figure 2.--Photo of the study area taken from one of the more significant viewpoints.

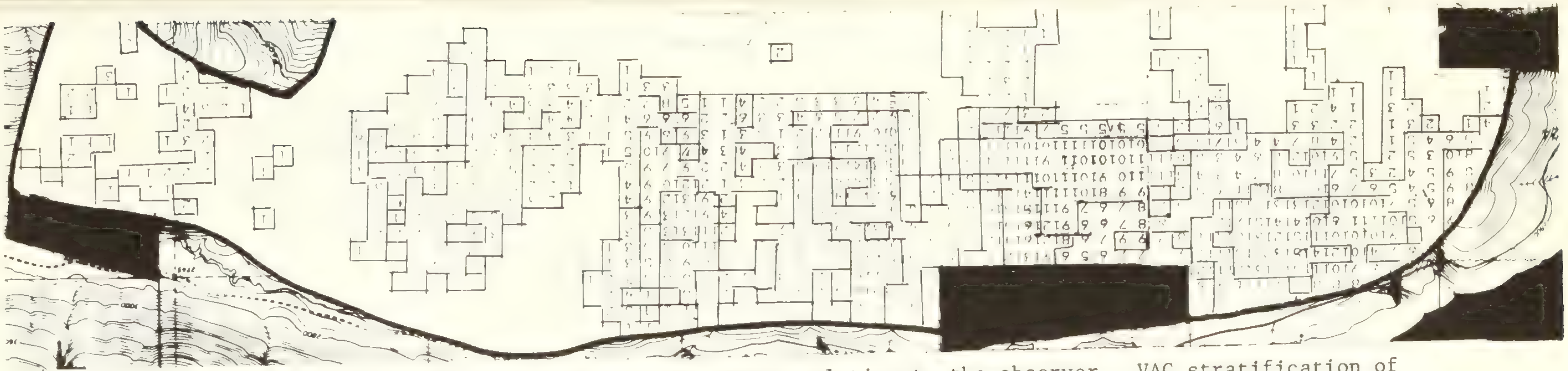

Figure 3.--VIEWIT numeric map using the program; aspect relative to the observer. VAC stratification of Ll (low) = 13-17, Ml (moderately low) = 8-12, M (moderate) = 4-7, Mh (moderately high) = 1-3 and H (high) = 0.

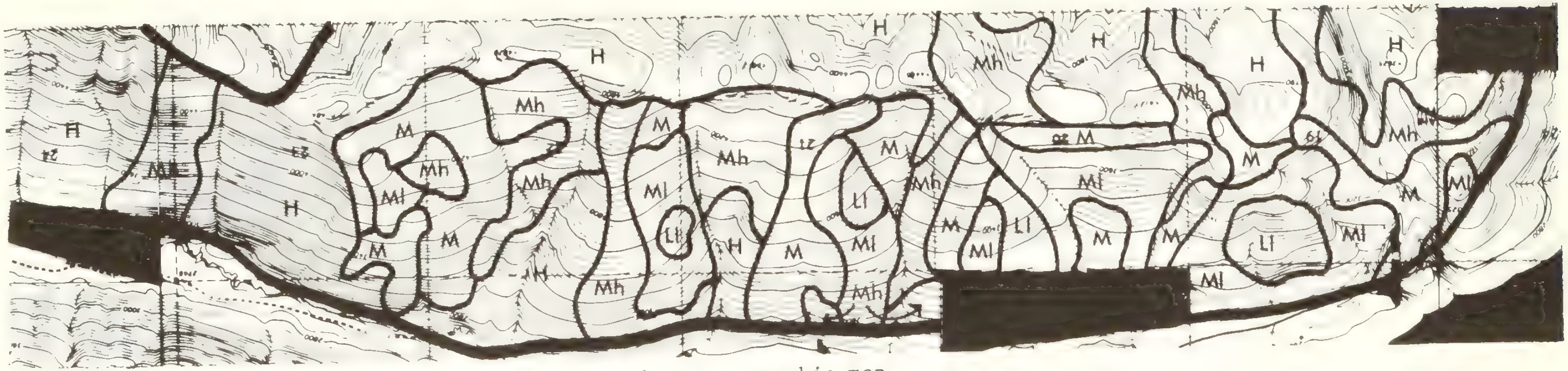

Figure 4.--Numeric map information converted to topographic map.

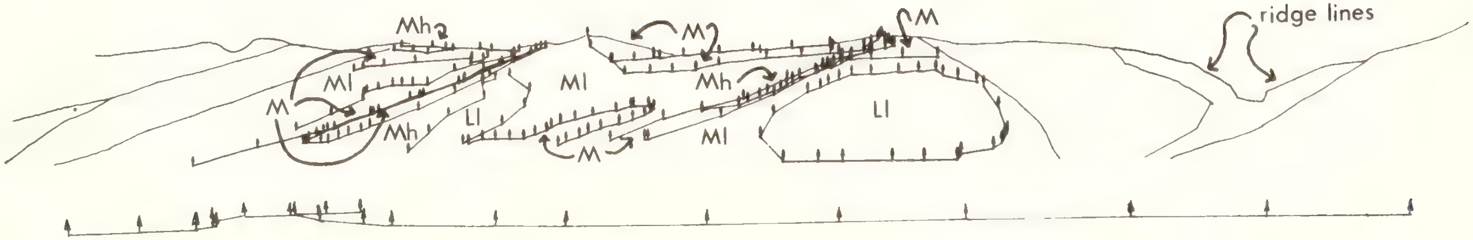

Figure 5.--Perspective of VAC stratification from Figure 2 viewpoint.

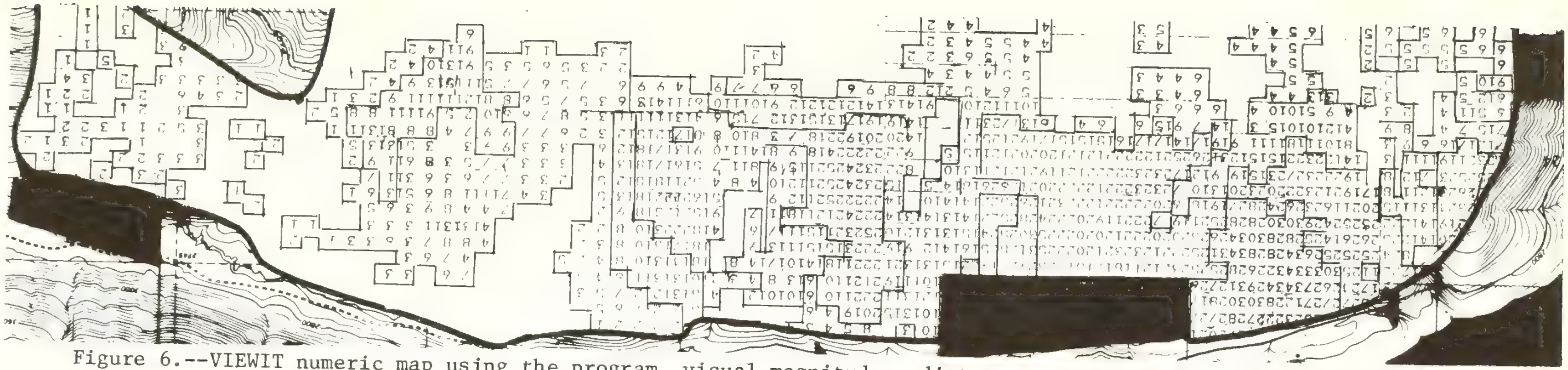

Figure 6.--VIEWIT numeric map using the program, visual magnitude - distance, aspect relative to the observer and times seen. The VAC stratification is Ll = 26-34, Ml = 17-25, M = 8-16, Mh = 1-7, and H = 0.

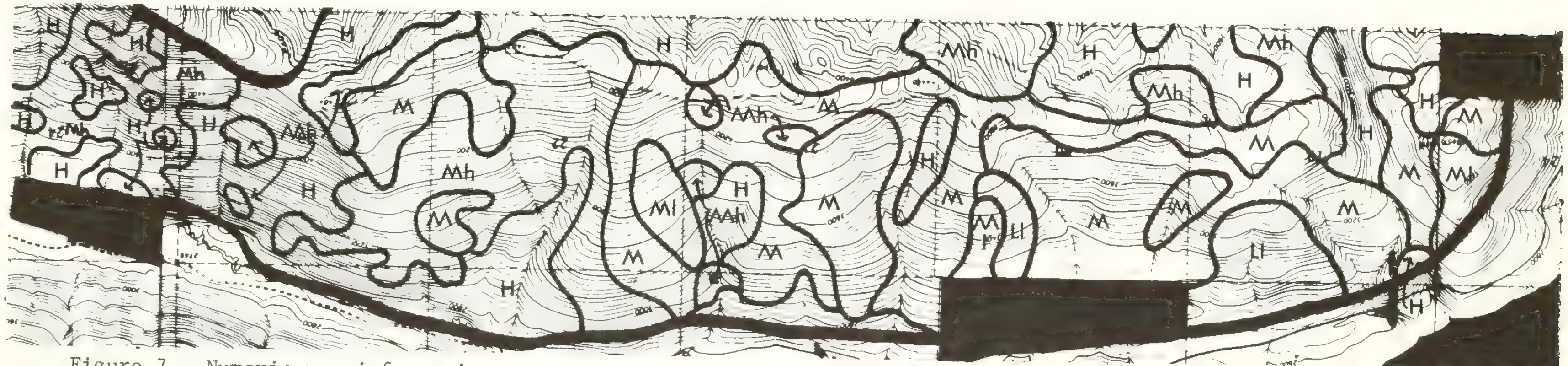

Figure 7.--Numeric map information converted to topographic map.

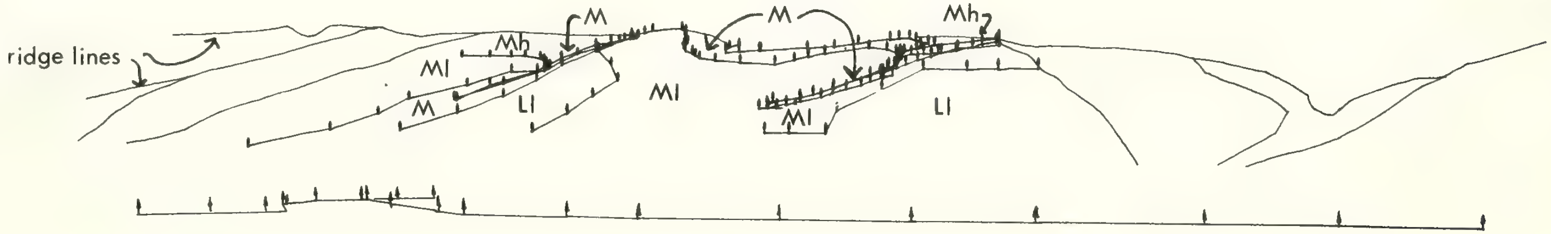

Figure 8.--Perspective of VAC stratification from Figure 2 viewpoint.

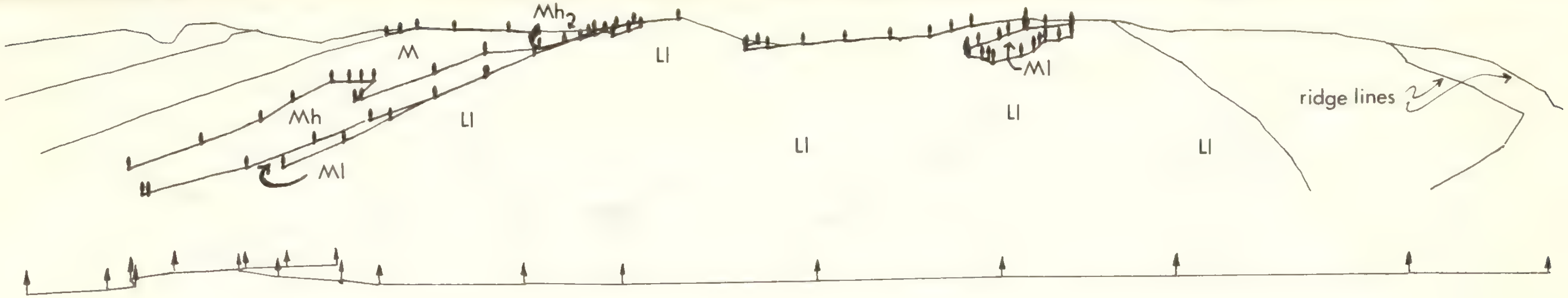

Figure 9.--Perspective of initial study area VAC map (figure 1).

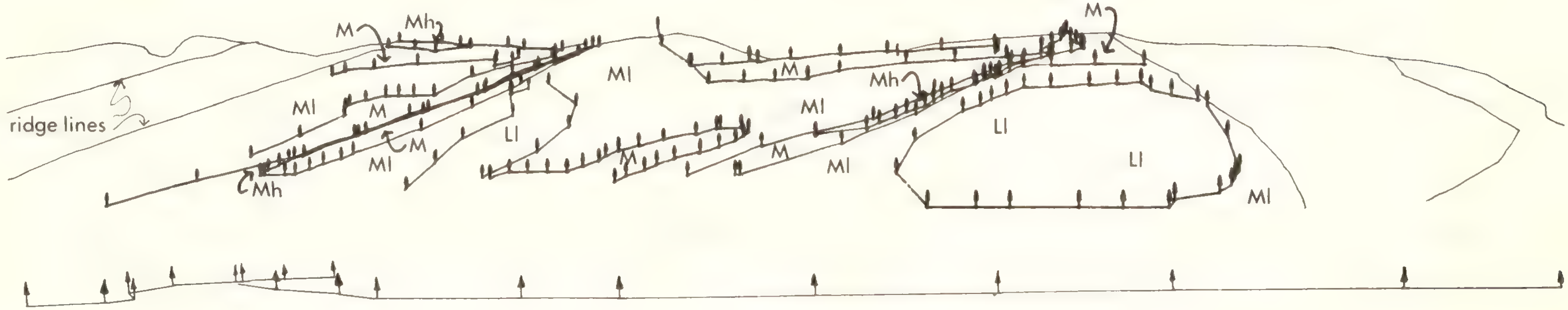

Figure 10.--Perspective of aspect relative observer program.

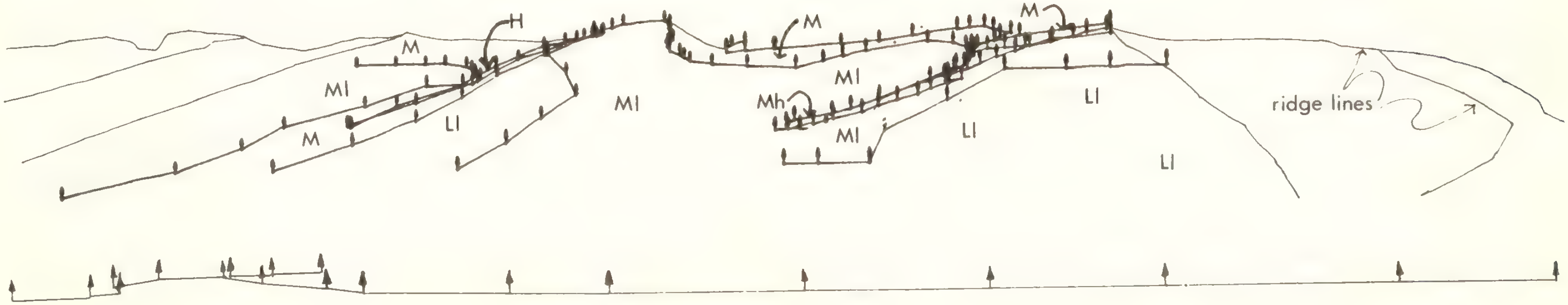

Figure 11.--Perspective of visual magnitude program.

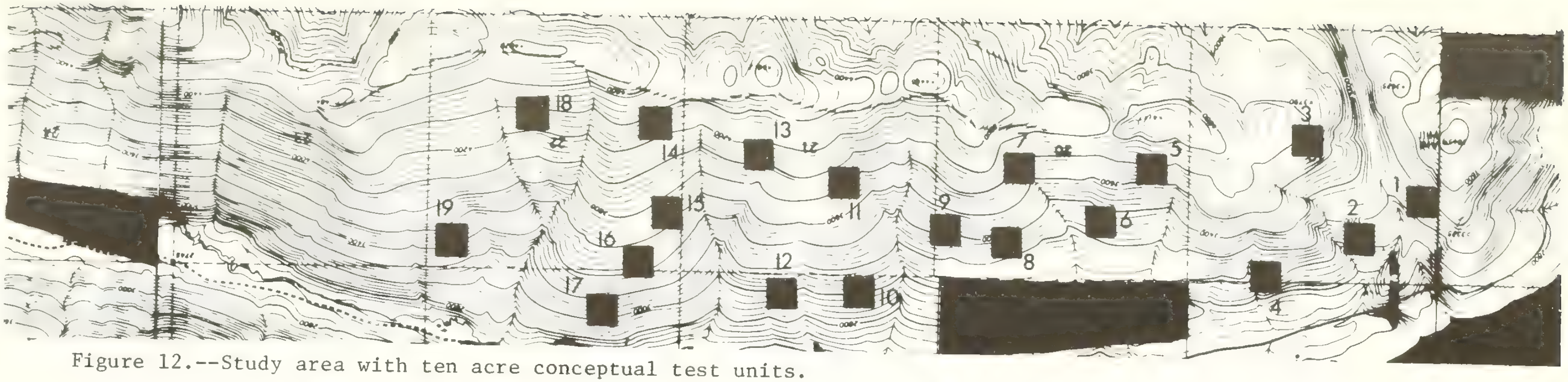

Figure 12.--Study area with ten acre conceptual test units.

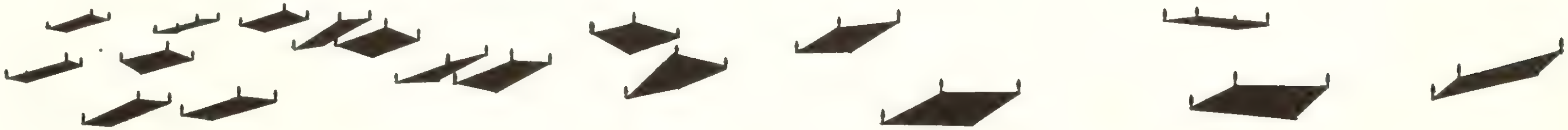

Figure 13.--Ten acre test units, displayed in actual size; in perspective from Figure 2 viewpoint.

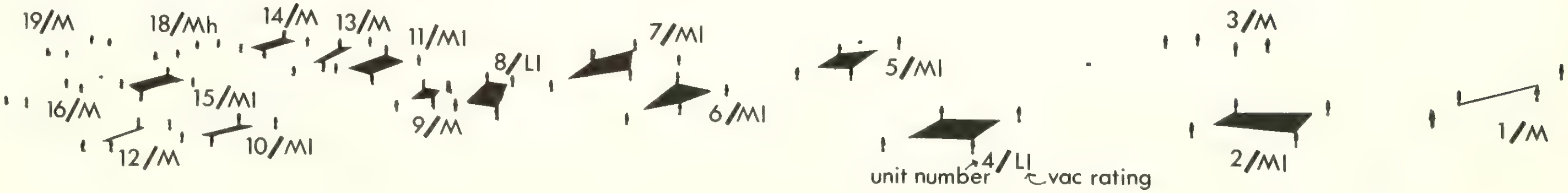

Figure 14.--Ten acre test units, displayed in apparent size; in perspective from Figure 2 viewpoint.

significant viewpoints were selected to determine the relative frequency of viewing for areas of the landscape.

The landscape architects established visual criteria to determine the landscape's Visual Absorption Capability. Slope, observer distance, aspect relative to observer, landscape complexity, frequency viewed, and vegetative condition were inventoried. An overlay for the study area was developed, showing the prominent features of primary ridges, secondary ridges, focal points, existing clearcuts, natural openings and areas with critical soil problems. The variables were individually mapped and then a combined process was used to develop a single VAC map (figure 1). This stratified the study into five absorptive levels. The map was used in developing both silvicultural prescriptions and timber harvest concepts for a proposed sale (Tlusty 1979).

After completion of the proposed sale an informal study (Tlusty _et al._) was conducted to determine the relative accuracy of the overlay VAC process. It was also suggested by team members that increased detail would be useful. The comparison was conducted using the VIEWIT program of aspect relative to the observer and times seen and the visual magnitude concept using distance, aspect relative to observer and times seen (Elsner 1975). Two numeric maps were generated (figure 3 and figure 6). An important analysis within both programs combines groundslope with relative observer elevation to determine viewslope (Iverson 1975).

Each numeric map was stratified into five levels, this allowed comparison with the initial five level VAC map which was developed primarily by overlay techniques. The five levels on the two numeric maps were replotted on topographic maps (figure 4 and figure 7). This allowed computer generated perspectives to be drawn from one of the significant viewpoints (figure 2). The VAC unit boundaries (figure 9, figure 10 and figure 11), were drawn using Perspective Plot (Twito 1978) for all three VAC maps.

The visual magnitude VAC map (figure 7), also had ten acre square conceptual harvest units delineated in each of the five absorptive levels (figure 12). Perspectives were generated from the same significant viewpoint (figure 2). Actual sizes, i.e., surfaces viewed without screening, (figure 13) and apparent sizes (figure 14) were determined by not delineating ground surfaces screened by 80-foot trees in the study area.

RESULTS

1. The visual magnitude option, of the VIEWIT program, allows many forest landscape architects quantitative visual assessment opportunities by combining viewslope, distance and aspect relative the observer.

2. Perspective Plot complements the visual magnitude option of VIEWIT and allows selected VAC unit stratifications to be drawn in perspective; and with a scale relative to on-site viewing. This process is faster, more useable and less costly than terrain analysis perspectives, generated with VIEWIT data. VIEWIT's best use is in broad scale planning and Perspective Plot is most effective at the project level.

3. By using both VIEWIT and Perspective Plot programs, users can obtain a high degree of accuracy in grouping numeric values into like visual absorption levels.

4. The visual magnitude map offered both more accurate and more detailed mapping stratification than the initial overlay generated VAC map. Increased stratification, with accuracy, is desirable as it provides more project useability and credibility in determining priority areas which require special landscape management techniques in silvicultural prescriptions and timber harvest concepts.

5. The VAC process allows broad visual resource objectives to be broken down into similar areas of absorptive ability, for specific project development. The process is most effective when specific development activities are assessed for visual absorption and accompanied by visual management guidelines.

SUMMARY

Presently there is an absence of VAC research which supports processes for local, intuitively weighted variables. Many forests presently have the ability to use both VIEWIT and Perspective Plot programs. These programs should be used to establish a quantitative rating for the visual magnitude variables of viewing distance, frequency an area is seen, viewslope and land aspect relative to the position of the observer. This information can be combined with overlays of the remaining significant VAC variables, i.e., vegetation type, vegetation height, soil color contrast, features and ridge positions which are not included in the VIEWIT program. This will allow more accurate VAC maps from which landscape management guidelines and design strategies can be developed.

The use of VIEWIT and/or Perspective Plot for VAC mapping in all project activity areas is not presently possible. But, the use of these techniques, in especially sensitive locations and on occasional test plots, will allow landscape architects to have increased accuracy and confidence, where more intuitive approaches are necessary.

ACKNOWLEDGEMENTS

Both Robert Reese and Valerie Weber Hillaird, landscape architects on the Kootenai National Forest, ran the computer programs and fully participated in the VAC evaluation process.

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Visual Resources and the Public: An Empirical Approach[1]

Rachel Kaplan[2]

Abstract: Visual resource management systems incorporate many assumptions about how people see the landscape. While these assumptions are not articulated, they nonetheless affect the decision process. Problems inherent in some of these assumptions are examined.

Extensive research based on people's preference ratings of different settings provides insight into people's experience of the environment. The procedure described here has several advantages: (1) It provides a means to evaluate the assumptions underlying alternative visual analysis models; (2) it provides some insights into the dilemma of agency/public mismatch; and (3) it provides a relatively straightforward mechanism whereby public input could be incorporated in visual management decisions.

INTRODUCTION

Any number of resource managers have come to the conclusion by now that one of the biggest obstacles they confront is not money, nor technical capability, nor well-trained staff. The big headaches come from people -- citizens, interest groups, locals, vocals. There are all too many examples of citizens upset by management decisions and upsetting well-laid plans which were arrived at by long, arduous, carefully developed procedures. The frustrations these situations reflect are matched on both sides. The managers feel unappreciated and resent being cast as evil-intentioned, power-hungry, insensitive bureaucrats. The citizens are deeply resentful that their needs and values are ignored and trespassed.

While the requirement for citizen input in decision making is an important step in the right direction, it has created problems that have made many doubt the wisdom of the requirement. In the area of visual resource management the problems are particularly apparent since designations like "scenic value" and "aesthetics" are inherently nebulous and subjective. Given how important the visual environment is to all of us, it is hardly surprising that the management of the visual resources should be particularly vulnerable to citizen outcry.

Part of the misunderstanding on the part of the public regarding the agencies' efforts stem from the public's lack of comprehension of the process by which decisions are reached. On the other hand, it may be that some of the negative reaction may be due to the fact that what people actually care about in the landscape is not adequately reflected in many management decisions. It is my feeling that this is an area of serious concern, deserving careful study. From the long list of potentially pertinent issues, I would like to address two specific areas: (1) The basic assumptions underlying many current visual management procedures; and (2) ways to incorporate public input about the visual environment into the decision-making process.

A LOOK AT SOME OF THE ASSUMPTIONS

The most widely adopted visual management procedures have in common that they are lengthy and complex. They include a large number of separate evaluations that almost magically culminate in a decision rule. One would certainly not be tempted to fault these agencies for a lack of thoroughness! When the public is informed of the many-step process leading to a decision, the response must be one of "Wow, they really did a lot of work!" But the audience must also leave the public session totally bewildered about most of these steps. Further, the apparent precision of the process obscures the question of whether what is being measured constitutes in fact the issues of greatest concern to these citizens.

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[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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The procedures underlying the visual resource management tools that agencies such as the U.S. Forest Service and Bureau of Land Management have adopted incorporate many issues that are clearly important. In examining the assumptions underlying these procedures it is not my purpose to be critical of the intentions. But it is important to recognize that any process is, in the final analysis, seriously affected by the assumptions built into it. When the final decision is the consequence of a series of assumptions that may be problematic, it is prudent to understand the relationship between these assumptions and consequences.

There are a number of ways in which a set of assumptions can be analyzed. They can be looked at empirically; that is, they can be evaluated in the light of research results. They can be considered in terms of pertinent theoretical conceptions. And finally they can be considered in terms of whether there is any basis for preferring them over alternative conceptions that might be offered in their place. Assumptions that are not obviously better or worse than alternatives are not necessarily false, but their apparent arbitrariness calls for further effort to clarify their status.

VARIETY CLASSIFICATION

The issue of whether the landscape is distinctive plays a key role in some visual resource management systems. "The classification is based on the premise that all landscapes have some value, but those with the most variety or diversity have the greatest potential for high scenic value" (Stone 1978). There is no question that certain distinctive patterns deserve such description, but is the issue of diversity the best factor to single out as prominent in potential scenic value? And is it the case that the most variety -- all other things being equal, if that were possible -- is likely to lead to the greatest scenic quality?

It is easy enough to imagine a scene of considerable variety and diversity that would be lacking in pleasantness or beauty. A tree farm might be rich in different species and quite low in scenic attributes. By contrast, a tranquil setting might well be less diverse -- perhaps even "common" in terms of this designation -- yet a scene worthy of an overlook

A study (R. Kaplan 1977) comparing visu preferences of local residents and tourists, carried out in the context of a scenic route designation project, suggests that among the scenes preferred by the locals are some rather "common" ones. At the same time they seem to be more sensitive than are the passing-through tourists to the kinds of landscapes that give the region its "flavor," its characteristic quality. This suggests that with time, as one becomes familiar with an area and consider it "home," one differentiates features that had previously blended into the background. A subtler form of variety and distinctiveness develops with familiarity -- perhaps one that the professional who lacks familiarity with the area fails to discern.

In much of our research we have also found that diversity, or variety, or complexity (different labels for essentially the same factor) is important to preference, but only in a limited sense. A lack of variety is not appreciated. Across numerous studies we have found that the wide, open, undifferentiated views are consistently rated lower in preference (S. Kaplan 1979). But in natural environments we have not found that increased complexity was related to increased preference.

REGIONAL CHARACTERISTICS

Federal agencies responsible for vast stretches of land are necessarily faced with problems at a regional scale. It is therefore important to find ways to characterize a region in terms of common physiographic and vegetative patterns.

At the same time one must not lose sight of the fact that such regional characteristics may be apparent in only some parts of the region This is no doubt more of a problem for some character types than for others. In regions dominated by mountains and valleys these patterns are consistently prominent. But for many other landform patterns the regional characteristics may be more evasive.

It may be useful to choose several regions that are similarly designated on topographic maps in terms of particular land form and land use combinations and to then take some number of photographs in each region. It is quite likely that from a scenic quality viewpoint these photographs would fare quite differently. In fact even from a land form and land use perspective such scenes are likely to bring surprises.

In one study where we attempted this it was certainly clear that the correspondence between map designation and the view from the road was poor at best (R. Kaplan 1977). Viewing videotapes taken along river corridors which are presumably similar in terms of regional characteristics also gives one the sense of significant scenic variation despite the common physiographic label.

SENSITIVITY DESIGNATIONS

Now that we can fly we too have a bird's eye view of everywhere. As such no landscape escapes visibility. But, of course, some views are much more frequently seen than others. The visual sensitivity codes that several of the visual resource systems have adopted are based on the assumption that those scenes that are more regularly viewed by more people are the more sensitive. In other words, people are more sensitive about those scenes that they encounter most readily. Or, at least, the manager is most vulnerable when altering landscapes that have the greatest likelihood of being seen.

The assumption of sensitivity based on volume of visibility is an interesting one. When the decision rule is to expose the highest sensitivity areas to least change there are some consequences that may not be desirable in the long run. Perhaps the public would be better educated about necessary environmental changes if these were not hidden from view. Perhaps the areas that are most heavily traveled are the ones that are least worthy of protection as they have already been heavily changed.

This is not to say that the view from the campground or from the visitor center is the ideal choice for maximum modification. But these places can serve as proper settings for increasing citizen awareness for the visual impact on environmental decisions. Rather than protect the public from the realization that clearcutting is going on a few thousand feet away, it may be more appropriate to point out where it is and that efforts are made to reduce the visual impact of such interventions.

The other side of the sensitivity zone philosophy is that it is less damaging to alter the view that the locals may have as they travel the tertiary roads, than the view the visitor has traveling the major routes. For the local group one is thus altering the everyday, familiar environment including areas that have, with time, acquired particular affections. It is hardly surprising that the displeasure of local groups is becoming more frequently heard.

THE ELEMENTS OF CONTRAST

Among the many attributes that landscape architects are trained to discern four have been identified as particularly important. The "dominance elements" of form, line, color, and texture (U.S. Forest Service 1973) have played key roles in the various visual resource systems. There is no reason to question that these are important elements, nor that alterations to the landscape can be viewed in terms of changes with respect to these elements.

The assumption to be examined with respect to the elements stems from the assignment of numeric weights to each of them. The Bureau of Land Management (1975) system, for example, assigns a weight of "4" to form, "3" to line, "2" to color, and "1" to texture. Thus, what might be considered a "strong" proposed change to the landscape would be four times as significant in its effect if the form were altered than if it entailed textural changes. The problem here involves both the assumptions of the relative importance of these four elements, and the magnitude of the differences. If different numeric weight were applied to the same four elements strikingly different consequences might ensue. Is the precision of these weights commensurate with our knowledge of the relative importance of these factors?

It would seem that a worthwhile project would involve exploring the properties of these numbers. Take a scene and radically change its form (a 12-point change), or take the same scene and alter it radically with respect to line and texture (also a 12-point change) but leave the other elements alone. Would these lead to equal judgments of change? The difference between a primeval forest and a second growth forest involves considerable textural change; our research suggests that the differences in texture weigh heavily in people's preference judgments (S. Kaplan 1979). Color, by contrast, is more difficult to evaluate. Cloud patterns lead to color changes much of the time, as do seasonal variations. The fact that black and white and color photographs do not lead to important differences in judgments, suggests that perhaps color does not play as important a role as this weighting system would suggest.

THEREFORE

Embedded in the various visual resources systems are assumptions about how people see the landscape, about the factors that are most important in affecting how they see it, and about the trade-offs to be made in considering environmental changes. A different set of assumptions might lead to significantly different decisions.

This is not an area where we know the answers and where any set of assumptions can be assured of widespread agreement. Perhaps the one statement that can be made with some confidence is that our knowledge of environmental perception, of factors affecting environmental preference, and of trade-offs between different options, is far from complete.

Given that decisions must be made and that they must be based on incomplete knowledge what options are available? Certainly, one option is to proceed as best one can, acknowledging the situation, but without becoming mired in the ramifications of our ignorance. But there are other options, too.

It would seem reasonable to encourage research that tests the underlying assumptions. There are many testable implications that could be checked in a variety of contexts. Empirical support might strengthen our confidence in the system that has been adopted.

At the same time, until such confidence is earned, it may be reasonable to adopt a system that makes apparent the consequences of any one set of assumptions. For example, a management system that requires two different alternative weightings of different key variables might facilitate the realization that decisions are closely linked to the assumptions. When the different versions lead to similar conclusions one can have greater confidence in one's decisions. When the different versions lead to less agreement, one must confront the differences rather than be blind to their existence.

Another modification of procedure would not only aid in comparing alternative assumptions, it might aid in the quality of the resulting decisions as well. It is characteristic of the methodology in this area to come up, finally, with a single number which incorporates all judgments, all weightings and all variables. Quite apart from the problem of combining incommensurates by a formula, such aggregating procedures oversimplify and understimulate. They fail to take advantage of the tremendous integrative capacity of the human mind. Humans excel in integrating patterns - their ability in this area far exceeds what is currently possible using computer and/or formula. Providing the manager with four or five or six components to deal with is likely to lead to far more sensitive and insightful decisions than providing only the mechanically combined composite of these components.

Another option which could be achieved right along with the others would incorporate input from the citizenry in the visual resourc assessment. The purpose of the next section is to describe a methodology for obtaining suc input in a way that makes sense to participant and that yields informative results. The methodology leads to information not only abou people's preferences, but about the perceptual categories they are using as well.

While these are probably enough justifications, there are certain other advantages of the methodology that might be judged as fringe benefits. It is also a means of informing people, of sharing information, perhaps even of helping the public understand the manager's dilemmas. There is thus a far greater likelihood of avoiding the unpleasantness, the frustration that all too often characterizes the manager/citizen interface.

AN APPROACH TO PUBLIC INPUT

It is easy to come to the conclusion that the public is unenlightened. Even after a thorough presentation of the procedures followed in arriving at a management decision, someone in the audience might ask a question revealing that little of the presentation was understood. Judging by the expressions of many others in the audience one can wonder if they followed much of the presentation. And the majority seem to be too disinterested to even come. Sure there is usually some individual or group that is outspoken and articulate, but they express their extreme self-interest rather than comprehending the complexity of the situation at hand. Were one to try to simply ask people for their recommendations -- for the management plan they think would be useful -- chances are they could not come up with anything useful.

But the public can also be portrayed in contrasting terms. People are highly capable; they process enormous amounts of information all the time, and with considerable facility. They can be frustrated, hostile and difficult when their ability to understand is stymied. People are concerned about their immediate surroundings, about things they know something about and that impinge on them directly. They care to understand and to be involved. Even if good things are done on their behalf, they would often rather have a piece of the action than to have things done for them. The key to useful exchange with the general public is the provision of information in a way that is comprehendible (Kaplan and Kaplan 1978).

One can find any number of examples of information programs that do no good; there are even examples where providing information can be confusing and damaging. The conclusion to be drawn is not that people do not care about information after all. Rather, one has to examine the way in which the information is provided and what the public was to get from it. With some understanding of the way people come to make sense of something and of ways to facilitate their involvement, public input can become much more enlightened.

Public involvement entails two quite different purposes. One is to inform -- that is to provide information -- and the other is to give the opportunity for reaction. Most public participation situations are carried out in a public context, where providing information to a large group can be achieved efficiently. The opportunity for reaction in such contexts is not achieved with as much facility, however. The fact that it is a public event, or in any case a group event, also leads to some dynamics which may or may not be useful to the process. While such opportunities are needed (and even legislated in some cases), they may not be the best way to achieve the desires of public involvement. The procedures discussed here are intended to supplement the public arena and to precede it in decision-making.

The approach to public input that we and our students have used in a wide range of situations stems from a theoretical framework of how humans experience the environment. The approach can be described as "just another survey" but there are some noteworthy differences. Surveys, interviews and questionnaires have in common that they ask people to respond to questions. That is also one of the purposes of public input. But the format that we have adopted is intended to serve the function of providing information as well as collecting reactions, and it is intended to be a positive experience for the participants (R. Kaplan 1979).

A PICTURE

Not all pictures are worth a thousand words. It is striking, however, what the presence of pictures does to participation. People are generally receptive to photographs and want to see them. A page of text is rarely met with the same enthusiasm. And these reactions are characteristic not only of the lazy, uneducated, disenfranchised, or otherwise excluded groups. It's true of all of us. Chances are you have looked at the photographs in these proceedings before you read a single article from beginning to end. Why is that?

Humans are visual animals. The significance of that statement is not only that we are sensitive to visual information and that we are likely to take in visual information around us. We also experience much information that is not directly visual through the visual mode. Visual cues can communicate smells and sounds and tactile differences. Advertising relies on this. You can "see" the wind, and "smell" the picnic in a picture without words, and seeing a couple holding hands conjures nonvisual modalities as well. Our language is rich in visual expressions for nonvisual experiences: "Let me see" and "as I see it" are common examples.

Two areas of information are particularly important to human functioning and both of these are readily communicated through visual modes, and quite difficult to grasp without the visual. One of these is space. The environment is a spatial experience and the location of things in space is vital to our understanding. In fact, there are many examples of imputing spatial characteristics to events that are not necessarily spatial to help in comprehending the information (S. Kaplan 1976). "Where is this discussion going" is a case in point. The other category of information that is readily provided visually is locomotion -- or changes in space. Pictures make it readily apparent if an environment is one where locomotion is facilitated or impeded, whether it is safe to venture forth or of uncertain consequences (S. Kaplan 1979).

In fact it might be argued that this is much of what people mean when they refer to an "experience" in a landscape. People experience the space, and they experience the process of entering and locomoting within the space. The picture is not a substitute for these experiences, but it is in an efficient code that allows people to assess it from these various perspectives. The assessment is, of course, very rapid and not conscious. The power of visual imagery is that it brings with it so much other information as well.

The format that we have been using includes visual material in the survey procedure. The pictures may be photographs or slides of existing places or of simulations. Generally, they have been black and white rather than color, and often they have been of remarkably poor resolution. But people are so adept at processing visual information that these factors create no problems. In fact, in many cases the lack of polish in the photography has advantages (cf. R. Kaplan 1979). It lends authenticity to the participatory activity. It communicates the sense that the input is in fact early in the process, before all the decisions have been reached.

CHOICES

When presented with a solution to a problem it is very difficult to ascertain what modifications are feasible. If the solution is satisfactory all is well, of course. But many times the solution does not seem quite right and yet it is difficult for the public to judge what possibilities are available. While this may be quite intentional, and the purpose of presenting a solution in glossy form may be to create the impression of finality, it is also the case that the espoused purpose of participation is to get meaningful input.

When presented with two feasible alternative solutions the possibility for meaningful participation is enhanced manifold. Not only do participants thus recognize that the "right" solution is not yet established, they also get a sense of the range of what is possible. Perhaps some elements from one solution and some elements from the other solution might be combined to yield yet another alternative.

A photoquestionnaire lends itself particularly well to the presentation of alternative solutions, or to different views of such alternatives. Using somewhere, let us say, between 20 and 50 slides or photographs it is not difficult to provide a great deal of information about the realm of the possible.

WHAT ARE THE QUESTIONS

The purpose of this format is both to provide information -- easily accomplished with pictures -- and also to obtain information about how the public reacts to the proposed alternatives or modifications to the environment (R. Kaplan 1979). A procedure we have found to be particularly effective for obtaining such reactions involves having participants rate each of the scenes in terms of how much they like it, or their preference. That is not to say that other questions cannot also be included and there are times when verbal analogues to the pictures provide useful checks on the responses to each. But the basic format of all these studies has involved preference ratings.

The purposes of these ratings are twofold. On the one hand, knowledge about people's reactions to each of the scenes is important. If the reactions are as idiosyncratic as some would expect, that is important to know. If, as we have found in many studies, the responses are much more predictable, that too provides useful information. While knowing the preferences does not necessarily mean that one heeds them unquestionably, it suggests that it would be wise to be prepared to explain decisions that are contrary to widespread consensus.

The preference ratings serve another purpose as well. They provide information not only about the participants' likes and dislikes, but also about their patterns of perceiving the environment. Through statistical procedures it is possible to ascertain the various themes or groupings or clusters or domains or dimensions that are salient from the public's point of view. Such categories more often than not are distinctly different from the categories that the expert manager is trained to utilize. By becoming acquainted with the important dimensions from the public's point of view, the decision-maker is provided with another way to "see" the landscape (S. Kaplan 1979).

In the case of the visual resource, such a clustering procedure can be useful as a check on the assumed categories and classifications that the agency's system assumed to be pertinent. If physiographic features are of dominant significance, one would assume that the grouping would show this to be true. If the organization of the visual environment is perceived in other terms, the groupings will reflect this too.

The point here is not that one grouping is right and the other is wrong, but rather that the different groups of people perceive the environment differently. The differences are informative. They can be useful in planning interpretive programs to help the public understand why certain decisions are made. They can also be useful in helping the expert see that there is another side to be considered. We have found that this process has on several occasions helped the landscape architect redesign a project.

FLEXIBILITY

Although this methodology arose in an academic context, it has proved itself to be highly practical and useful in a wide variety of settings. While there is no space here to describe each of them, it may be useful to mention a few to highlight their diversity.

Hammitt's (1978) study of a bog environment in a national forest (included in these proceedings) focused on the role of familiarity with that environment in people's preferences. Anderson (1978) studied preferences for different forest practices in a national forest and compared the categories as determined by participants' preferences with those generated by professional resource managers. Gallagher's (1977) study was concerned with naturalized landscapes; here again, people's knowledge about prairie restoration was related to preferences. The study of scenes along a storm drain in both residential and more rural areas related preference to people's familiarity with the particular settings (R. Kaplan 1977). Here it was interesting to discover that water is not always to be considered an amenity. Finally, citizen input was obtained before a vest-pocket park was built in a central business district. Here the visual material was based on a simulation (R. Kaplan 1978).

My proposal, then, is that a procedure like the one described here be used in conjunction with other visual management procedures. This promises to have at least three notable benefits:

(1) It provides a check on assumptions and on alternate perspectives to consider. This not only has research potential in the formal sense of the word; it is also highly educational. It is difficult to look over results obtained in this way without learning a good deal in the process.

(2) It provides a realistic means of obtaining public input, while it can still be useful and without the unpleasantness that so often accompanies dealing with the public.

(3) It is likely to make the public feel more favorable toward visual management activities -- and rightly so, since they will have been given the opportunity for informed and meaningful participation in the process.

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Measuring Familiarity for Natural Environments Through Visual Images[1]

William E. Hammitt [2]

Abstract: An on-site visual preference methodology involving a pre-and-post rating of bog landscape photographs is discussed. Photographs were rated for familiarity as well as preference. Preference was shown to be closely related to familiarity, assuming visitors had the opportunity to view the scenes during the on-site hiking engagement. Scenes rated high on preference were likely to be scenes that visitors rated most familiar. In addition, familiarity ratings indicated that visitors were quite cognizant of what scenes they had or had not seen during the on-site hike. A single on-site experience was enough for visitors to recall what they had seen, with repeat visitors showing no apparent increased familiarity. Thus, considerable information concerning natural environments appears to be processed and recorded by visitors during on-site experiences.

INTRODUCTION

Familiarity is known to be an important component of environmental preference, be it visual or otherwise. Familiarity gained through prior information and past experiences can be vital to how humans will react to an environmental scene. The way people perceive and think, the way they take in and process information from the environment, are a consequence of past experiences (Kaplan and Kaplan 1978). Through past experiences, people develop cognitive models of their environment, which in turn, aid in the perception of future environments.

To date, we know little concerning those properties of natural environments that aid or hinder the construction of cognitive models. What kinds of environmental qualities are important in the development of cognitive representations of environmental events, places and scenes? What about the cognitive processes involved? How instrumental is each environmental encounter, and in particular, preferred environmental encounters, in cognitive model formation? Most resource managers would agree that such information is important if we are to manage for visual and environmental preferences. Mercer (1975) points out the importance of this area of research in outdoor recreation when he suggests that future studies include, "how recreation behavior and environmental preferences are learned and how the mental maps of recreationists develop." This paper attempts to answer a portion of Mercer's question by determining what visitors remember visually from an on-site recreational experience. Certainly, recall or recognition is an initial step in the cognitive model or mental map process.

An information processing and cognitive map approach to how individuals know and relate to their environment is not new. Tolman proposed the cognitive map idea in 1948. But it was Lynch (1960) who really developed the idea when he had individuals sketch "mental maps" of their cities. Lynch found that people have different cognitive models of their cities, depending on individual experiences, and dominant features of various cities. Downs and Stea (1973), and Moore and Golledge (1976), provide additional articles which develop the cognitive model idea. Many of these references, however, pertain to urban and other man-made physical environments. Kaplan and Kaplan (1978) and their colleagues have investigated various natural environments for preference from an information processing and cognitive model approach. Of particular interest to this paper is a study by R. Kaplan (1976), which involved the use of different materials and experiences to familiarize people with wayfinding in natural environments. Both the materials (i.e., maps, photographs) and the experiences (i.e., games, etc.) were evaluated as to their effectiveness in aiding individuals to develop adequate internal models of the environment.

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The purpose of this study was to investigate the relationship between visual preference and resulting familiarity for natural environments. The rating of photographs for familiarity following an on-site environmental experience, in order to determine the degree to which visual information enters memory, is an approach new to the literature. Would one expect preferred scenes to be more likely to be remembered, and perhaps be a basis for cognitive models? The familiarity issue, of course, depends ultimately on the adequacy of an individual's internal model of the environment developed as a result of on-site encounters.

CONCEPTUAL BACKGROUND

The conceptual basis underlying the design of the present study and the interpretation of the results is based on a theory that involves how people process environmental information and form cognitive models. Simply stated, the theory proposes that humans, as evolutionarily successful organisms, are efficient at processing environmental information, and that humans are constantly building mental models of the environment they experience. Through environmental encounters, humans are exposed to considerable environmental information, which is processed and incorporated to varying degrees into mental representation of the external environment. The mental models which one develops from environmental encounters are, in turn, instrumental in how one interprets future environmental encounters. As stated by Kaplan and Kaplan (1978):

> the cognitive map (or mental model) provides a link between the human thought process and the physical environment. The way an individual experiences and reacts to a given environment begins to be understandable in the context of an experience-based internal structure that corresponds, at least in certain respects, to the environment in question (p. 43).

Also basic to the conceptual framework of this study is the belief that humans are primarily "visual" processors of environmental information. While the perception of natural environments is a complex process, involving all of our senses--our past experiences and their lasting traces in memory, it is vision that humans depend on most for relating to the environment. Sight is of crucial importance and probably influences human response to environments more directly and with greater salience than do our other senses (Shafer 196 Even when the other senses are involved in the processing of information, it is seldom that they are not associated with a visual image, either called-up from memory or existing in th physical environment. Preference for certain environments or aspects of environments depend largely on the visual resources perceived in that environment and the associated informatio processed with that encounter and past encount Through repeated experiences, humans group int classes or categories (Bruner 1957) or schema (Attneave 1957) those visual images which the encounter most frequently, find intriguing an gravitate toward for various reasons. Thus, recognition of objects and environmental scene is an important function of cognitive model theory.

Even though humans are primarily "visual" processing organisms, and much of this information is coded in memory, it should be realized that the visual information is not recorded as a "picture." Kaplan (1978) points out that:

> While the (cognitive model concept) may be equated in a very rough way with the idea that a person has a 'picture of the environment' in his head, the information is far more schematic and incomplete than 'picture' implies, to say nothing of the fact that this 'picture' will in general never have been seen all at once (p. 56).

The mental "picture" is an approximation to reality, an approximation that will vary according to individual experience level.

If, indeed, humans do formulate mental models of their environment, based primarily on visual encounters, then one could hypothesize that: on-site experiences in natural environments could be important in cognitive model development of such environments. In addition, since much of the on-site information is processed visually, the use of photographs might be a logical approach for abstracting what visitors do perceive and record mentally during on-site encounters. Differences in recognition of what images become most familiar during on-site experiences could benefit resource planners and managers involved in providing visual resource experiences.

PREFERENCE - FAMILIARITY STUDY

During the summer of 1977, a total of 400 visitors were interviewed while visiting the bog environment of Cranberry Glades, Monongahela National Forest, West Virginia. Visitors had access to the bogs by way of an interpreted boardwalk trail. Some visitors were asked to view and rate black and white photographs of the bog resource just prior to a hike on the bog boardwalk and then again after the hike (fig. 1, group 1). Other visitors were shown the photographic questionnaire only upon completing their hike (groups 2 and 3). In both cases, visitors were asked to indicate their visual preference (on a 5-point Likert scale, ranging from 1 = preferred not at all to 5 = preferred very much) for each photographed scene. At the end of the hike, information was also obtained about visitors' feeling of how familiar various photographs seemed (groups 1 and 3). Familiarity was defined as the visitor's recall of having seen a scene or a photograph of it during the hiking experience. A 3-choice option (familiar, not familiar, not sure) was provided for recording familiarity. Information was also obtained about visitors' previous visits to the study area.

Photographs for the study questionnaire included some taken by visitors, some furnished by the interpretive staff of the Cranberry Glades and some furnished by the researcher. To obtain visitor photographs, 15 visitors to the bog were given instamatic cameras prior to the actual survey date and asked to photograph bog scenes and features as they hiked the trail. From the three sources (visitors, interpretive staff and researcher) of photographs, 24 photos were selected for inclusion in each of two versions of the questionnaire (see Hammitt 1978a, for a detailed description of methods and selection criteria for representative photographs). A few bog scenes from Michigan and from bogs adjacent to the study area were also included with the Cranberry Glade photographs for testing a portion of the familiarity component of the study.

FAMILIARITY AS A COMPONENT OF VISUAL PREFERENCE

What Visitors Remember

Visitors seemed to have little trouble determining which scenes they had seen and which they had not. For some of the bog scenes as many as 90 percent of the participants indicated they were "familiar" with the scene. Thus, visitors appeared to be quite cognizant of what they saw during the on-site bog experience. Far fewer participants used the "not sure" option than anticipated ($\bar{X}$ = 16 "pct"). The efficiency of participants' cognitive system for recognizing what they had seen was further demonstrated when visitors were able to recognize similar bog scenes from Michigan, or adjacent bogs near the study site, as having not been seen during the on-site

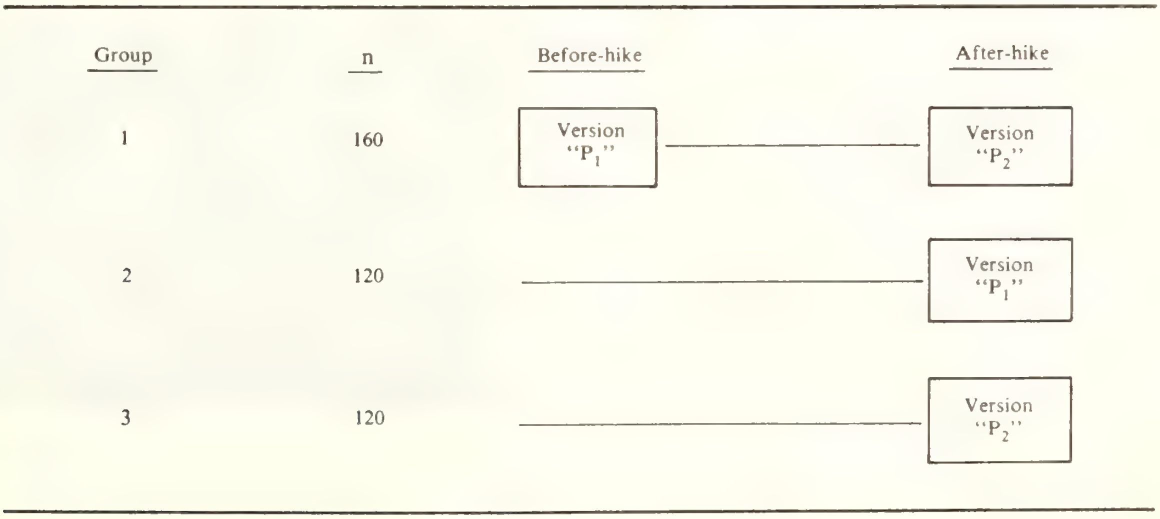
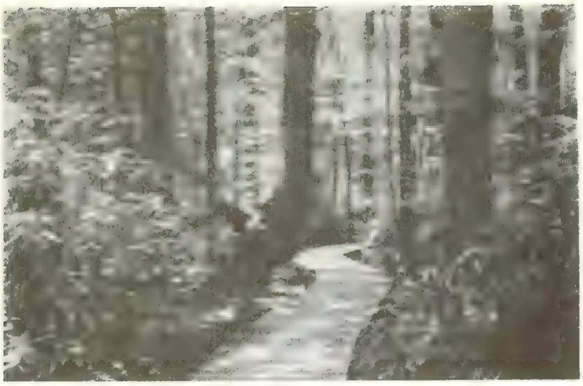


Figure 1. *Research paradigm for sampling bog visitors.*



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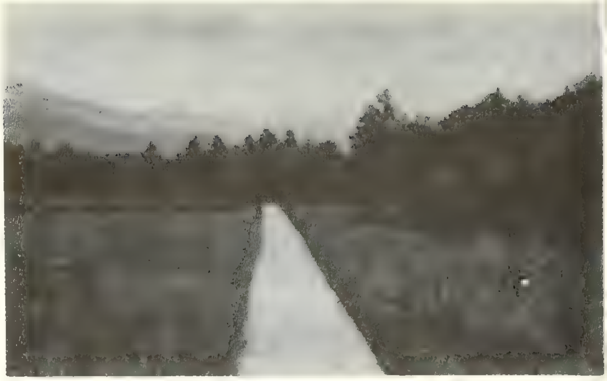

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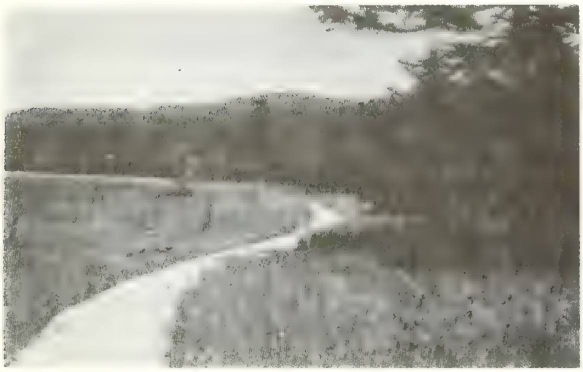

Photo 45 88.7%

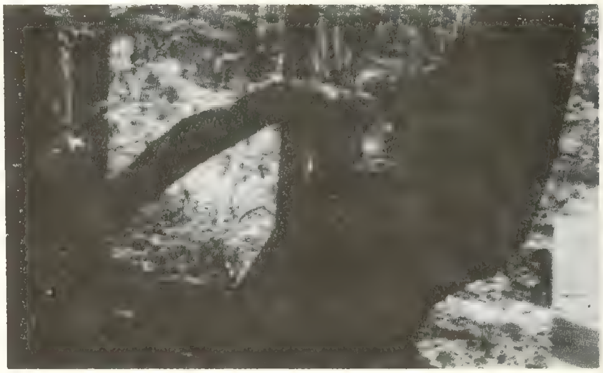

Photo 31 86.5%

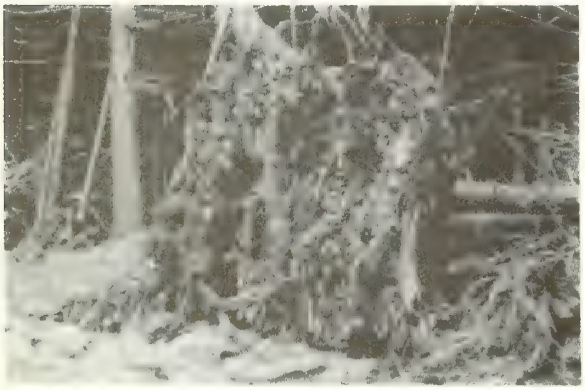

Photo 40 84.3%

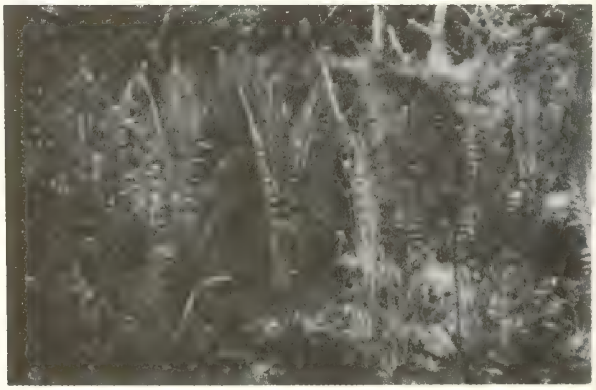

Photo 47 79.2%

Figure 2. *Six most familiar bogscenes based on familiarity ratings.*

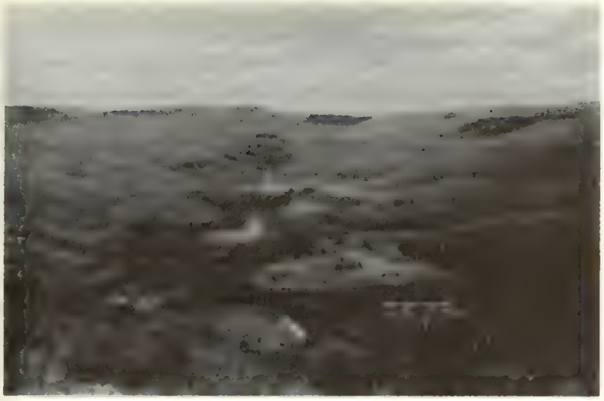

Photo 39 23.4%

Photo 27 29.9%

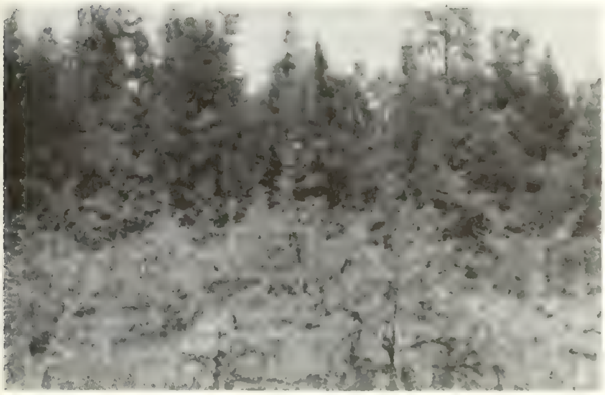

Photo 44 32.1%

Photo 35 33.6%

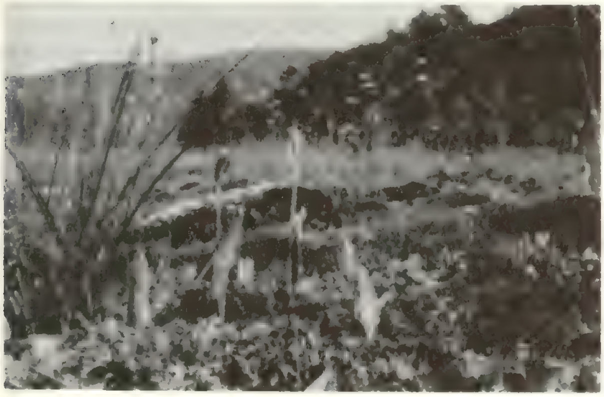

Photo 41 34.3%

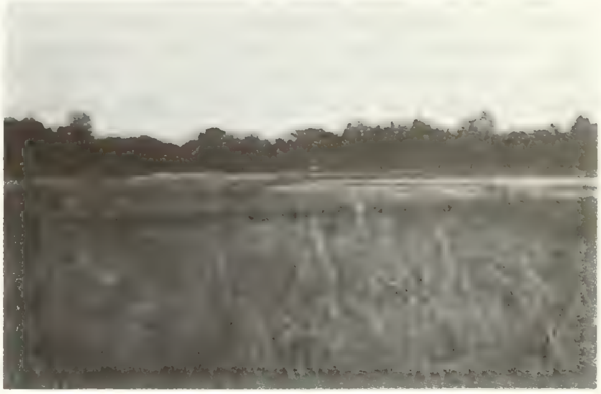

Photo 42 38.0%

Figure 3. *Six least familiar bogscenes based on familiarity ratings.*

hike.[3] Five of the six control or off-site photos were among the eight least familiar scenes.

Figures 2 and 3 show the six most and least familiar scenes, respectively, based on the percentage of "familiar" scores. Some interesting patterns emerge when one examines the scenes for elements which aid and hinder familiarity. The six most familiar or most remembered scenes are characterized by two main bog components, boardwalk and distinct features. All of these scenes are quite distinctive and identifiable, and as a consequence, visitors were quite sure as to whether they had viewed the scenes. The three "feature" scenes (photos 31, 40, and 47) are all landmarks along the boardwalk, while the boardwalk itself (photos 36, 33, and 45) is a dominant element in the visual pattern experienced during the hike.

Familiarity for the features and the boardwalk correspond well with the findings of Lynch (1960), Devlin (1976) and R. Kaplan (1976). Lynch found that two of the major components in the "sketch maps" of city dwellers were landmarks (features) and paths (boardwalk). Both Lynch and Devlin found these two components to be among the initial elements that people incorporate into their cognitive models. Only with additional experiences, over time, were details added to one's model. Kaplan, in the study of way-finding skills, states, "a critical component of these skills must be the capacity to identify distinctive aspects of the environment. Landmarks are vital to cognitive map development; their identification is enhanced when one is sufficiently well acquainted with the setting to know what is distinctive." Of course, the uniqueness, novelty and even function served by landmarks will have a bearing on how acquainted one must be with a setting to know what is distinctive. As will be discussed later, in the case of recognizing scenes which were seen during the bog hike, even a single experience seemed to be adequate.

The least familiar scenes tended to be those which lacked distinguishing features and or were scenes which visitors, in fact, were unlikely to have seen during the hike. Photos 27, 44, and 42 were of a bog environment in Michigan and, thus, fall into the latter category. Scene 35, though on-site, was also probably not seen, due to visitor viewing orientation being concentrated opposite this edge scene, toward the open bog mat. Photos 39 and 41 represent a different story in that they were both distinct, novel and memorable scenes which the visitors did not see (#39) or due to the non-existence of a good orchid display during the 1977 summer (#41). Late frosts during the spring of 1977 caused the poorest flowering display of orchids at Cranberry Glades in recent years (USDA Forest Service 1977).

Influence of Prior Information and Visits on Familiarity

One might hypothesize that the viewing of photographic materials before an on-site experience, or familiarity with a setting through previous visits, would influence the ability to recall what had been seen during the on-site experience. The pre-post and control design of this study allows for investigating the first of these relationships. Even though group 1 viewed photographs (and rated them for preference) before the hike, they were at no apparent advantage over group 3 (who did not view photos before the hike) when both groups rated the photos for familiarity at the end of their hikes (rho = .97). The percentage scores were quite similar and only two photos (#38 and #48) were somewhat discrepant in their ranked position (table 1). The lack of influen of prior visual information on familiarity for scenes viewed during the on-site experience, indicates that the familiarity ratings were based on the on-site cognitive experience rathe than on exposure to the prior photos.

The influence of prior visits on visual recall can be examined in terms of differences in familiarity scores for first-time visitors versus repeat visitors. Only one photograph showed any significant difference (chi-square test) in familiarity rating as the number of previous visits to the bog increased. Thus, it appears that a single on-site experience is sufficient for developing a sense of familiarity.

It is important to keep in mind that in this study only visual recall of on-site scenes was measured as an indicator of familiarity. This does not mean that repeat visitors might not be more familiar with the environment if other indicators of familiarity were measured. Nevertheless, it is important to know the degree to which visual information enters memory as a result of on-site experiences, for this certainly can be important in the initial phases of cognitive model development.

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[3] Rating of the photos for preference and familiarity took place at the trailhead, in a forested area and out of sight of the photographed bog scenes. Thus, participants were required to recall what they had seen; it was impossible for them to see the scenes during the interview process. Visitors rated the photos 20 or more minutes after the hike began, as the boardwalk trail was ½-mile in length.

It is also intriguing that visitors were so very cognizant of the visual information they had processed while engaged in a recreational activity. The behavior of visitors while hiking the trail (or for that matter, participating in any other recreational activity) would lead one to believe visitors "are just having a good time and the acquisition of information is the last thing taking place." Yet, information processing theory predicts that visitors necessarily have an efficient cognitive system for "knowing" the natural environment.

Table 1 -- *Influence of prior photographic information on familiarity scores. Group one of bog visitors viewed photographs before the hike, group three did not.*

Frequency (percent) of "Familiar" Scores				
Photo No.	Group 1		Group 3	
	"pct"	rank	"pct"	rank
36	92.3	1	94.9	1
33	92.3	2	91.5	2
45	90.4	3	86.4	4
40	85.9	4	82.2	6
31	85.3	5	88.1	3
25	77.6	6	78.0	7
47	75.6	7	83.9	5
29	73.7	8	77.1	8
32	73.1	9	69.5	9
37	63.5	10	61.0	11
43	60.9	11	69.5	10
30	56.4	12	60.2	12
46	55.8	13	54.2	13
48	51.9	14	36.4	19
28	50.0	15	54.2	14
26	48.7	16	50.0	15
34	46.2	17	47.5	16
42	35.9	18	40.7	18
41	35.9	19	32.2	20
35	35.3	20	31.4	21
38	34.6	21	44.1	17
44	34.0	22	29.7	22
27	31.4	23	28.0	23
39	24.4	24	22.0	24

Familiarity and Visual Preference Relationship

When the preference and familiarity scores were ranked and compared, a positive relationship was revealed (rho = .53); figure 4. However, as figure 4 indicates, the majority of the scenes show a very strong relationship between familiarity and preference. The two scenes (photos 39 and 41) that were highly preferred but very low in familiarity have been encountered previously. Both scenes are feature oriented, but were not available for visitor viewing during the on-site hike (photo 39 is the oblique view and 41 the seasonal orchid view). Visitors liked the scenes and perhaps because they were distinctive, were quite sure they had not seen them on-site. Photo 40 represents the only instance of very low preference and yet high familiarity. This scene was of an uprooted tree, a negative feature in the pattern of boardwalk events, which visitors did not appreciate but had no difficulty recalling.

How might the relationship between familiarity and preference be explained in terms of environmental cognition and the mental models which humans develop during on-site experiences? When an environmental setting is non-district, featureless, and offers little opportunity for individuals to become visually involved, they might be expected to pay less attention or to pass more rapidly through such areas. In preferred environmental settings, they are likely to pay more attention and thus, increase contact and familiarity. Also operating along with greater attention for preferred scenes is the fact that one prefers the scenes that are more distinctive, that help in orientation as distinctiveness is easier to remember. Thus, an environmental scene high in the cognitive domains of "distinctiveness" and "involvement" is more likely to be attended, and such prolonged contact should enhance familiarity. It is further proposed that the enhanced familiarity is a component of cognitive model development during on-site engagements.

Although preference appears to lead to familiarity, a cautionary note is in order. While high preference for a scene tends to be associated with a high degree of familiarity for that scene, one is reminded that the opposite situation, of high familiarity being associated with low preference, can also occur. Familiarity can lead to increased preference, but familiarity, per se, is insufficient basis for appreciation. One can be very familiar with non-preferred aspects of an environment.

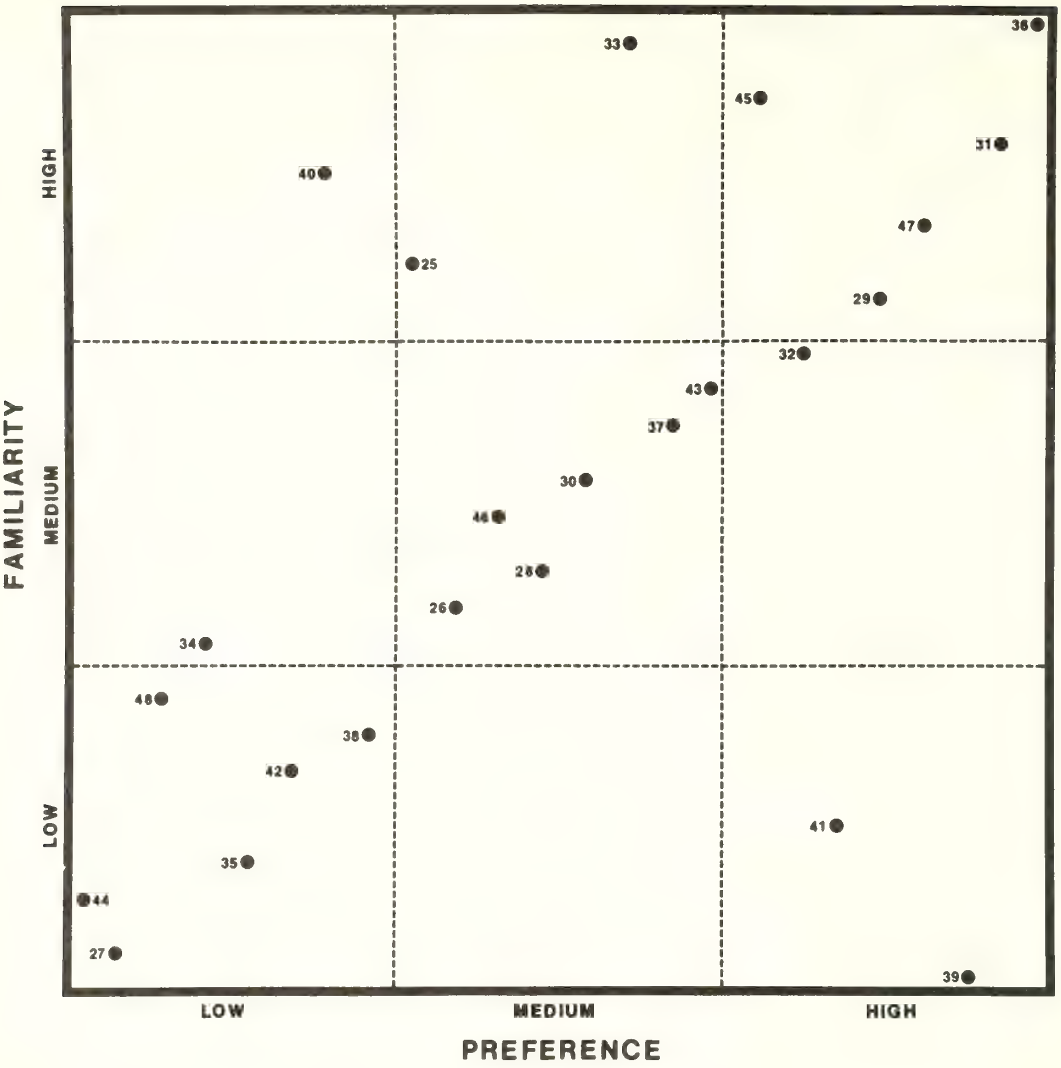

Figure 4 -- *Relationship of visual preference to familiarity for photographs of a bog (n = 274; rho = .53).*

SUMMARY AND CONCLUSIONS

Familiarity resulting from an on-site experience with a bog environment was studied in a number of ways. What do these reveal about familiarity resulting from encounters with natural environments?

Familiarity was examined in terms of people's ability to recall visual information which they had experienced. After just one on-site experience, visitors were quite cognizant of what scenes they had viewed and had not viewed. Neither viewing of photographs before the on-site hike nor prior visits to the bog were shown to be of advantage in terms of visual information recall.

Comparison of familiarity ratings with preference ratings for the same scenes showed a positive relationship between the two variables. The photos which were most preferred by visitors were also most remembered, assuming visitors had a chance to view the actual scenes. The least preferred scenes were likely to be scenes with which visitors were not familiar, due to the photos being of an off-site bog. But, the relationship of preference and familiarity is more complex than that of a direct relationship.

It would appear that visitors are processing considerable visual information during on-site experiences in natural environments, and that much of this information is entering memory, at least for a short while. It also appears that preferred environmental settings and scenes aid in the memory process. If this is true, planned and preferred environmental experiences could be quite instrumental in the development of cognitive models on the part of visitors to natural environments. As stated elsewhere (Hammitt 1978b), the importance of visual information processed as a result of on-site experiences in natural environments might be simply to predispose people to respond to further information--to provide people with the initial cognitive structures to incorporate future on-site experiences. After all, it is the continuing sequence of experiences that eventually underliesa person's thinking and behavior.

Some examples of how the visual preference-familiarity relationship might be operationalized by resource managers are: the design and layout of hiking trails, scenic car tours and even the development of environmental interpretive experiences. Areas can be field inventoried for distinct features and scenes which serve as landmarks, and have been shown to enhance familiarity. Situations, such as dense undergrowth or a low hanging branch, which serve as a visual barrier, lend themselves to designing the "bend in the trail" where part of the visual information is hidden and offers the element of visual involvement. Students in an "Environmental Interpretation" class at The University of Tennessee had little trouble in incorporating both the distinctive and hidden information components into the layout of forest trails when given the assignment. Trails designed to include "visually preferred" as well as "ecologically preferred" information could offer the trail visitor a more rewarding experience. And, since the visually preferred is more likely to attract attention and be remembered, could it be that an interpretive message located at a preferred scene might likewise be more likely to be remembered. Such a possibility encourages further research.

While the reviewed technique and approach for measuring familiarity and preference of natural environments have the greatest application in planning and designing preferred environmental experiences, there are various other visual resource and land management situations to which it can be adapted. The fact that the methodology is quite economical, requires little statistical software and is an approach that involves on-site public involvement in the management of visual resources should encourage its future use. As inferred by Mercer, we have a long way to go in understanding the mental maps of people, especially as these maps relate to the experiencing of visual and recreational resources.

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The Q-Sort method: Use in Landscape Assessment Research and Landscape Planning[1]

David G. Pitt and Ervin H. Zube[2]

Abstract: The assessment of visual quality inherently involves the measurement of perceptual response to landscape. The Q-Sort Method is a psychometric technique which produces reliable and valid interval measurements of people's perceptions of landscape visual quality as depicted in photographs. It is readily understood by participants across a wide range of age groups and cultural backgrounds, and it provides data which can be mapped within a region and/or statistically compared to various social and physical dimensions.

INTRODUCTION

The Need for Psychometric Methods

The assessment of visual resource values in landscape planning encompasses, by definition, an investigation of a fundamental relationship between an observer and a landscape being observed. Litton, et al(1974) suggests that aesthetic response to landscape is produced by the interaction of three factors: Characteristics of the observer (e.g.,viewing and/or use expectations, environmental disposition, ethnic and demographic characteristics, etc.); characteristics of the landscape being observed; and the physical and behavioral context in which the observation occurs.

In the course of several centuries of practice, landscape architects and others have developed a body of theory to deal explicity with aesthetic response to landscape. Much of this theory is based on the premise that the visual field received by the human eye consists of patterns of lines, planes, forms, textures, colors, light and spaces which all may vary according to direction or orientation, shape and size. Pleasing composition is hypothesized to occur when these design elements, with all of their infinite variations, are selected and organized according to the principles of unity, variety, dominance, balance and rhythm (see Graves 1951). At the risk of over-simplifying a fairly complex set of relationships, it is theorized that the basic goal of good composition is to provide enough variety to hold interest, command attention and provide stimulation within a unified context that forces all parts of a design to read as a single entity.

Developed in part to predict perceptual response to (and guide design of) small parcels of land, these theories have recently been extended to the assessment of visual quality in large scale regional landscapes (Zube, et al. 1972; Fines 1968; Litton, et al. 1974; and USDA - Forest Service 1974). All of these models are based on two underlying assumptions:

1. The assessment of visual quality can be explained predominately in terms of the physical elements of the landscape being evaluated; and
2. The perception of landscape visual quality is consistent across all socio-economic and cultural classes in society.

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The testing of these assumptions has been attempted in several recent landscape perception studies. General support exists for the assumption of concordance among the perceptions of diverse groups of people (Daniel and Boster 1976; Zube 1973; and Zube et al. 1974). However, discretion must be exercised in the extension of these findings throughout society. For example, in a comparison of the perceptual responses of 13 demographically defined groups to landscapes in the Connecticut River Valley, Zube et al. (1974) found strong agreement among the perceptual response patterns of all but one group. Inner-city residents of Hartford, Connecticut consistently gave responses that varied from those of the remaining 12 groups.

Several studies have attempted to develop empirical models to explain perceptual responses to landscape in terms of the physical dimensions of the landscape being observed (Shafer, et al. 1969; Zube et al. 1974; Crystal and Brush, 1978). From a research perspective, the findings are impressive. The predictive strengths of these models vary from 66 to 77 percent. However, in a management context, the application of even the strongest of these models means that 23 percent of the time, the model user will not be able to predict accurately perceptual responses.

The existence of idiosyncratic perceptions of landscape values among certain groups in society and the relative inaccuracies inherent in current landscape perception models suggest the need for psychometric methods that will enable the visual resource manager to inventory quickly and accurately the perceptions of people observing the resource being managed. Schomaker (1978) notes that, in addition to providing a means for testing the assumptions of visual resource management models, psychometric methods also possess strong utility as a tool for participatory planning and decision-making.

Purposes of Paper

The purposes of this paper are to present:

1. Desired attributes of psychometric methods for use in landscape planning and landscape assessment research.

2. The Q-Sort Method as a psychometric method for assessing visual quality in the landscape.

3. An analysis of the strengths and weaknesses of the Q-Sort Method.

DESIRED ATTRIBUTES OF PSYCHOMETRIC METHODS FOR LANDSCAPE ASSESSMENT

In a research context, Daniel and Boster (1976) note that psychometric methods for landscape assessment must be both reliable and valid measures of people's perceptual responses to landscape. In a management context, one should add the dimension of utility as a desirable characteristic of psychometric methods. Resource managers face the dilemma of obtaining accuracy in landscape measurement at a reasonable cost.

Reliability of Psychometric Measurements

For a psychometric method to be reliable, it must be capable of producing consistent results in different applications to the same landscape. Different applications to the same or similar observer populations must also produce consistent results (Daniel and Boster, 1976). Reliability in the context of landscape assessment has several dimensions including:

1. If slightly different views of the same landscape are presented to the same population of observers, will the method produce consistent evaluations?

2. If the same landscapes and views are presented to randomly selected sub-sets of the same population, will the responses be consistent?

3. To what extent does the range of landscapes being presented to an observer affect the observer's evaluation of a given landscape? For example, if the presentation of five landscapes as part of larger collection of 10 landscapes significantly alters the relative values that would normally be ascribed to these five landscapes when presented as a discrete set, the measurement system is probably unreliable.

Validity of Psychometric Methods

The use of any measurement system implies an assurance that the system does, in fact, measure that quality it purports to measure. For example, measurement of air temperature requires the use of a thermometer; a hygrometer will produce measurements of a quality related to air temperature, but it will not measure temperature. Psychometric methods of visual quality assessment must elicit evaluative responses to the visual attributes of landscape. They must avoid confusing visual quality assessments with observer preferences or assessments of resource use potentials (Craik 1970).

In addition to actually measuring the quality they purport to measure, psychometric methods of landscape assessment must also provide meaningful differentiation in the measurement of visual quality. They must do more than sort the beautiful from the ugly. They must provide guidance in the evaluation of landscapes in the middle of the beautiful-ugly continuum, a spot shared by a large majority of the nation's landscape.

Finally, any underlying assumptions involved in the use of a psychometric method must be explicitly stated and tested for validity.

Utility of Psychometric Methods

To have value as a research and/or planning tool in landscape assessment, psychometric methods must be both reliable and valid; but they must be useful to the manager/researcher and understandable by the people whose perceptions the methods elicit.

Utility for the Manager/Researcher

From a management perspective psychometric methods of landscape assessment can be evaluated in terms of the extent to which their results are compatible with and/or comparable to other methods of resource assessment. Does a given method produce results which are mappable and/or capable of being included in resource management decision-making? Researchers are interested in the nature of the data produced by a method (nominal, ordinal, interval or ratio) and the extent to which the results of a given method can be statistically analyzed and related to other aspects of the aesthetic experience (i.e.,various landscape and/or human dimensions).

For both managers and researchers, questions concerning ease of administration and total cost are relevant. How much previous knowledge and/or training is required to administer a given method adequately? What are the costs of obtaining usable data from the method in terms of materials, data analysis sophistication and time?

Participant Understanding

The utility of any psychometric method ultimately depends upon the extent to which it can efficiently elicit perceptual responses. Methods requiring lengthy explanations or the completion of many complex tasks may frustrate participants, lowering the quality as well as quantity of responses. Methods involving use of abstract concepts may prove unsuitable for use with certain demographically or culturally determined groups of people. Furthermore, instructions for the use of psychometric methods must be understandable, and participation in landscape assessment projects employing psychometric methods must be at least nonthreatening and, ideally, enjoyable.

DESCRIPTION OF THE Q-SORT METHOD

Evolution from Personality Assessment Research

The Q-Sort Method originated as a technique of personality assessment (Stephenson, 1953,and further described in Block, 1961). For personality assessments, descriptions and evaluations of a subject's personality are obtained from a group of trained panelists. A series of personality description statements are typed separately on cards. Each panelist is given a set of the cards and asked to consider the extent to which each statement is characteristic of the subject being evaluated. Each panelist sorts the cards into a prescribed number of piles ranging from most descriptive to least descriptive of the subject. The piles represent points along a continuum describing relevance to the subject. Each pile is assigned a numerical value which is ascribed to all statements placed in the pile. Upon completion of the sorting of statements by all panelists, the values assigned to each statement are summed across panelists. A mean value is calculated for each statement to indicate the extent to which it is characteristic of the subject in the combined perceptions of panelists. Various statistical analyses (e.g., correlation, regression, and factor analysis) are applied to the mean values to explore personality dimensions of an individual and to compare personalities of different subjects.

Use of the Q-Sort Method (the prefixing letter"Q"has no special significance) requires resolution of two fundamental issues: how many piles should be used?; and should any limits be placed on the distribution of the sorted items among the piles, and if so, what is the most desirable structure of this distribution? Miller (1956) postulates that none of the human senses can discriminate sensory perceptions into more than five to nine categories. This suggests that nine might be an upper limit on the number of piles. Lower limits must be established on the basis of the number of items to be sorted and the level of differentiation that is desired among items. As the number of piles increases, so does the potential for finer discrimination among items.

Use of forced distributions (i.e., prescribing the number of items that must be placed in each pile) as opposed to unforced or free distributions has been criticized as an unnecessary and unnatural constraint on panelist decision-making. In defending the use of forced distributions in personality studies employing the Q-Sort Method, Block (1961, p. 78) notes:

1. The unforced Q-sorting procedure obscures recognition of the correspondences existing among evaluations of personality where the forced Q-sorting procedure permits a clear assessment of the degree of equivalence.

2. The unforced Q-sorting tends to provide fewer discriminations than the forced Q-sorting procedure and consequently is more susceptible to the Barnum effect, the tendency to say very general and very generally true things about an individual.

3. The unforced Q-sorting is not more reliable than the forced Q-sorting, even though with the latter procedure judges are forced to make discriminations they otherwise are inclined not to offer.

4. The unforced Q-sorting does not appear to provide information not also available and more easily accessible through the forced Q-sorting procedure.

5. The unforced Q-sorting procedure provides data which are unwieldy and at times impossible to work with where the forced Q-sorting procedure provides data in a convenient and readily processible form.

Block also notes (1961, p. 79) that the form of this distribution is not critical. He has found a unimodal distribution most useful because it forces more decisions at the extremes of the concept being explored.

Adaptation of the Q-Sort Method to Landscape Assessment

In adapting the Q-Sort Method for use in landscape assessment, the subject of evaluation shifts from an individual's personality to a concept describing visual response to th landscape. Terms such as scenic quality (Zube, et al., 1974) scenic beauty (Daniel and Boster 1976) or simply beauty (Zube and McLaughlin 1978) have been used as descripto of this concept. Rather than sorting personality description cards based on their relevance to an individual's personality, panelists sort landscapes according to the extent of their scenic value, scenic beauty, etc. In contrast to its personality assessment counterpart, the landscape assessment Q-Sort Method does not insist upon high levels of training among panelists. Part of its utilit is that it is readily adaptable for use by just about everyone with visual acuity.

An explicit and valid (Shafer and Richard 1974; Zube et al. 1974) assumption inheren in the use of the Q-Sort Method is that visua response to landscape photographs is consiste with visual response to actual landscapes. The physical impossibility of comparing and sorting large numbers of actual landscapes in the field makes this a necessary assumption. Regular and wide-angle or panoramic photograp may all be used. Photographs are enlarged (e.g. to a 5" x 7" format) and mounted on cardboard for durability. Depending upon the extensiveness of the assessment project, multiple sets of the mounted photographs may be developed.

Panelists are given a photographic deck and asked to sort the photographs into a predetermined distribution based on the scenic or visual quality associated with the landscape depicted in each photo. In studies involving 307 subjects sorting 56 photographs into seven piles, the authors (Zube et al. 1974) have found the following per-pile distr bution and set of instructions to be useful.

Pile	1	2	3	4	5	6	7
Number of Photographs	3	7	11	14	11	7	3

> Please sort the fifty-six photographs into seven piles according to the scenic quality of the landscapes in the photos. In pile number 7, place the three landscapes that you think have the highest scenic quality. In pile number 1, place the three landscapes that you think have the lowest scenic quality. From the remaining fifty landscapes place the seven with the highest scenic quality in pile number 6 and the seven with the lowest scenic quality in pile number 2. You will now have the thirty-six landscapes; place the eleven with the highest scenic quality in pile

> number 5 and the eleven with the lowest scenic quality in pile number 3. Place the remaining fourteen landscapes in pile number 4. The number of photographs to be placed in each pile also appears on the pile identification cards on the table in front of you. You may rearrange the photographs until you are satisfied with their placement, but make sure you place the specified number of photographs in each pile.

Values are assigned to the piles along the the continuum of lowest scenic quality (value = 1) to highest scenic quality (value = 7). The values assigned each photograph are summed across panelists, and a mean scenic quality value is calculated for each photograph.

EVALUATION OF THE Q-SORT METHOD

As described previously, psychometric methods of landscape assessment must possess three inherent characteristics: Reliability (the ability to produce consistent results); validity (they must measure the concept they purport to measure); and utility (both to the method's user and to its participants). As described below, the Q-Sort Method possesses varying amounts of all three attributes.

Reliability of the Q-Sort Method

Effects of View Variation

The effects of slight variation in view presentation on the consistency of results produced by the Q-Sort Method have not been rigorously tested. However, in a deck of 56 photographs sorted by 307 subjects, Zube *et al*. (1974) included three sets of essentially matching landscape pairs. In each case, photographs were taken either across the street from each other or from two points separated only by a few yards distance. All three pairs were obtained from relatively homogeneous landscapes (in terms of land form and land use/cover). The scenic quality means of each photograph within all three pairs, as obtained from the sortings of 307 participants are consistent. For one pair, the means are identical.

Pair Number	Scenic Quality Mean[3]	
	Photo I	Photo II
I	3.48	3.16
II	2.58	2.58
III	3.82	3.76

Effects of Subject Variation

To examine the consistency of the Q-Sort Method when used by different sub-sets of the same population, Zube *et al*. (1974) asked three matching pairs of subject groupings to sort the same deck of 56 photographs. While no two groups of people are ever going to be completely identical, it was assumed that people in a similar occupational status exhibit commonality. Pair I contained two groups (N=27 and 33, respectively) of men and women who are employed as natural resource managers by various government agencies (e.g., Soil Conservation Service and USDA-Forest Service). The second paring contained two groups (N=27 and 28) of male and female clerical personnel working for the same company. Pair III contained two groups (N=22 and 23) of professional landscape architects and students of landscape architecture. As illustrated below, strong correlations exist between each matched pair, implying that strong consistency was obtained in separate application of the Q-Sort Method to subsets of the same population.

Population Group	Correlation Coefficients[4] of Paired Groups
Natural Resource Managers	.96
Clerical Personnel	.85
Landscape Architects	.94

Effects of Contextual Variation

The absolute value of the scenic quality means produced by the sorting procedures are bound to be affected by two factors: the number of piles into which the photographs are sorted (this determines the potential range of the means); and the range of landscapes included in the photographic deck. However, the absolute values of any psychometric method of landscape assessment indicate nothing other than the position of a given landscape with respect to other landscapes. The real issue is whether the relative positioning of landscapes (as measured by the psychometric method) is altered by the context (i.e. range of landscapes) with which they are presented.

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[3] Potential range of Means is 1 to 7. Actual range for 56 landscapes is 1.44 to 6.45, as derived from 307 subjects.

[4] Pearsons r.($p \leq .001$).

To answer this question, Anderson et al. (1976) included the 56 photographs initially developed by Zube et al. (1974) in a deck of 217 photographs. The larger deck of photographs was sorted by 30 participants into seven piles with a per-pile distribution as follows:

Pile	1	2	3	4	5	6	7
Number of Photographs	15	25	40	57	40	25	15

The correlation coefficient (Pearson's r) between the mean scenic quality values of the 56 photographs obtained from the intial study (N=307) and the values obtained for the same photographs from the subsequent study (N=30) is .92 (p<.001). Thus, the relative positioning of the 56 landscapes was unaltered by the expanded context in which they were subsequently evaluated.

Validity of the Q-Sort Method

As a Measure of Visual Quality

Visual quality is an abstract concept. As such, it is difficult to determine whether a psychometric method actually measures visual quality in the landscape. One approach to this issue is to compare the results obtained from one method to those obtained from other methods when the same views of the same landscapes are shown to the same subjects.

In their study of scenic quality in the Connecticut River Valley, Zube et al. (1974) used three formats to elicit perceptions of scenic quality. Eight panoramic photographs of rural landscapes were shown to 184 subjects. The subjects were asked to describe each landscape using a series of seven point semantic scales (Osgood et al. 1957). Included in this scale was the continuum beautiful-ugly. After completing the scales for all photographs, subjects were asked to rank-order the eight scenes from highest to lowest scenic quality. Finally, wide angle photographs of each scene were included in a deck of 56 photographs Q-sorted by each subject following the Q-Sorting procedures described earlier.

A mean semantic scale response to each panoramic photograph was calculated over all 184 subjects. Mean scenic quality values for each of the eight photographs were also calculated based on results of the Q-Sort. Both sets of means were rank-ordered and compared to each other and to the rank-ordering of the panoramic photographs. The Q-Sort data are highly correlated with those of both the semantic scale and the panoramic photograph rank-ordering. These data suggest that the Q-Sort Method is measuring a concept similar to those involved in the use of the beautiful-ugly scale and the straight rank ordering for scenic quality.

Mode of Analysis	Correlation Coefficients[5]		
	SS	PA	QS
Semantic Scale (SS)	--	.99	.97
Panoramic Rank-ordering (PA)		--	.97
Q-Sort (QS)			--

To differentiate meaningfully various levels of visual quality, the distribution of values produced by psychometric methods must be distributed among all points on the measurement scale being used. For example, if in evaluating 100 landscapes on a seven point scale, the combined responses of 20 participants produces a distribution in which 10 landscapes fall on the highest point of the scale, another 10 fall on the lowest point, and the remaining 80 receive a value of four (the midpoint), the scale does nothing more than differentiate the extremely beautiful from the extremely ugly. It provides no guidance in evaluating visual quality between the two extremes.

To a certain extent, the distribution of values produced by the Q-Sort Method will be a function of the distribution that is specified in the sorting instructions. The specification of a forced normal distribution in sorting procedures will tend to provide a normal distribution in responses. The distribution of responses obtained from the sorting of 56 photographs by 307 participants (Zube et al. 1975) is illustrated below. A bell-shaped distribution was prescribed for each participant in the sorting instructions. The pattern of the observed distribution obtained from the combined sortings of all 307 participants resembles that of the individually prescribed distribution except that its kurtosis is higher and it does not cover the highest point on the scale. While a pronounced clustering of values is apparent in the middle points of the scale for the observed distribution, this clustering is spread over three scalar values, indicating a measure of differentiation within the cluster

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[5] Spearman's r. ($p \leq .01$)

Scale Value	Percent of Photographs Included: Prescribed Distribution for each Participant	Percent of Photographs Included: Observed Distribution from 307 Participants
6.50-7.0	5.4%	0.0%
5.50-6.49	12.5	3.6
4.50-5.49	19.6	32.1
3.50-4.49	25.0	37.6
2.50-3.49	19.6	19.6
1.50-2.49	12.5	5.3
0.5 -1.49	5.4	1.8

Utility of the Q-Sort Method

To the User

Within a region where visual resources are being inventoried as a first step in the management process, photographs may be randomly selected following procedures outlined by Daniel and Boster (1976). The photographs could then be Q-Sorted by various types of user groups or by a randomly drawn sample of a given population. The means obtained from the sortings of the photographs by the participants could be treated as data points on a statistical surface that describes visual quality within the region. The characteristics of this statistical surface could then be mapped to illustrate regional variations in visual quality. Through the use of marker scenes (i.e. scenes that are repeated in various Q-Sort decks of photographs) visual quality variations among regions could be analyzed.

In a research context, the perceptions of several types of subjects as elicited by the Q-Sort Method may be compared. Perception of visual quality may be related to specific human and/or landscape dimensions (e.g.,age and education; and topography, vegetation, etc.).

Because subjects essentially administer the Q-Sort Method to themselves, it requires little in the way of administrator training. Other than the photographs, the Q-Sort Method requires no audio-visual equipment. It can be administered in any setting which provides enough room for participants to place the photographs in piles. With some mechanical ingenuity, managers and researchers could readily adapt the Q-Sort Method to an electronic response panel for use at visitors centers, community centers, etc., or for a mail survey format.

Participant Understanding

It has been the experience of the authors and others that most people asked to use Q-Sort procedures have clearly understood and enjoyed the process. The tasks required of participants are relatively simple and concrete. Subjects are asked to sort out the best and the worst from a deck of photographs, set these aside, and complete the same tasks from those that remain until the desired distribution has been obtained. Participants in research conducted by the authors seem to enjoy having the ability to proceed at their own pace, and the character of participant comments spontaneously elicited by the Q-Sort Method is diverse and rich.

CONCLUSIONS

The Q-Sort Method is not a panacea for the visual resource manager or researcher. It is but another of the psychometric methods adapted to study people's perceptions of visual quality in the landscape. Use of the Q-Sort Method relies on an inherent acceptance of photography as a landscape presentation medium and imples a willingness to accept a measure of judgemental interdependence in the sorting process.

Data produced by the Q-Sort Method are both mappable and capable of being used in parametric statistical analysis. It appears to be as reliable and valid a measure of visual quality as most other psychometric methods. The Q-Sort Method is highly transportable, and it is based on intuitively understandable and apparently enjoyable procedures which require little in the way of administrator training. While its present form limits the number of people who may simultaneously used the method, thereby restricting potential sample size, adaptations in the form of electronic response panels or mail surveys can overcome this limitation.

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Complexity and Valued Landscapes[1]

Michael M. McCarthy[2]

Abstract: The variable "complexity," or "diversity," has received a great deal of attention in recent research efforts concerned with visual resource management, including the identification of complexity as one of the primary evaluation measures. This paper describes research efforts that support the hypothesis that the landscapes we value are those with perceived diverse and variable environments.

INTRODUCTION

In the following discussion, the terms "complexity," "diversity" and "variety" are used interchangeably. As defined here, the three words are all related to opportunities available in a given environmental setting. It is hypothesized that:

> The most complex or variable environments offer the greatest potential for quality experiences. The landscapes that we value would be those that maintain a variety of recognizable entities (rather than unordered diversity which is simply confusion). Such variety can be either within place (diversity) or from the norm (uniqueness or rarity). To search for valued landscapes is a process of noting variety or complexity.

The following expression would represent a linear form of the proposed hypothesis.

VL = TS, MA P.
where
VL = valued landscapes
TS = time and scale
MA = measurable attributes
P = perceptions

The specification of time period (era) and scale (boundary conditions and unit size) allow the other measurable attributes to determine the importance of a cultural or natural resource being examined. Often linear changes in time or scale will introduce non-linear changes in measurable attributes. As a consequence: a) time and scale can alter the manner in which an entity can be measured and b) properties may emerge at one time or scale of consideration but not at another.

This difference in measurable attributes of complexity can be presented by the following descriptors (the initial idea of such an evaluation of measurable attributes was presented by the author in an earlier paper, Zube *et al*. 1978).

rarity: the state of being permanently infrequent, the only one or one of remaining few.

uniqueness: archetypal, the best of its kind.

Part of a complex; diversity;

1) an ensemble of different landscapes;

2) a network of varied landscapes.

3) a permanent, periodic or seasonal series of natural or cultural processes.

Perceptions constitute the entire range of individual, societal and political concerns that affect the selection and management of natural and cultural resource areas. In a mathematical sense, these concerns are the coefficients or weights that influence the measurable attributes.

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If a relationship could be demonstrated between independent measures of landscape complexity and perceived environmental quality, then a preliminary verification of the above hypotheses could be made. This paper describes research efforts that reinforce those assertions. This study includes:

1. Identification of different study areas representing a variety of ecosystems and levels of complexity.
2. Data collection of information about the areas including remote sensing and in situ techniques.
3. Independent assessment of complexity levels from the collected data.
4. Independent assessment of environmental quality/visual interest of sites within the study areas.
5. Correlation and analysis of relationships.

METHOD

Study Areas

Data for this research were collected from a series of transects throughout southern Arizona. The basin and range landform conditions of this region have resulted in a variety of ecosystems. A number of different classification systems have been proposed as descriptors of these different plant and animal communities (Lowe and Brown 1973, Shreve and Wiggins 1964). The communities in which transects were laid out include: 1. Montane coniferous forest, 2. riparian deciduous woodland, 3. encinal and mexican oak woodland area, 4. plains and desert grasslands. To illustrate the arguments of this paper two specific transects and two study areas within this range of communities were selected:

1. Plains and desert grassland--A grama grass (Bouteloua spp.) dominated community. The specific study transect described throughout the remainder of this paper is located in the San Rafael Valley, Santa Cruz County, Arizona, at a mean elevation of 4900' (1490 m.). The study area is 3.4-miles long and 2.0-miles wide (5.6 x 3.2 km.). Occasional wet areas or "cienagas" throughout the site give rise to some riparian vegetation which are utilized by the rancher-owners of the land to form earthen water "tanks." The primary land ownership is private and the use is essentially ranching/beef production.

2. Riparian woodland - an ecologically diverse community typically restricted to permanent or periodic water courses along canyon or arroyo sites. Distinctive wildlife and plant communities distinguish these areas from surrounding arid areas. The study transect utilized in this paper is located near the town of Patagonia, in Santa Cruz County, Arizona. At a mean elevation of 4300' (1300 m.) the site is dominated by woody vegetation, predominantly Fremont Cottonwood (Populus fremontii), and Arizona Sycamore (Platanus wrightii). The study area is 3.4-miles long and 2.1-miles wide (5.4 x 3.4 km.). The ownership within the area includes a non-profit conservation organization and individual private holdings. The uses of the area are principall related to nature appreciation.

For the purposes of this paper it was deemed important to select two rather different study areas to illustrate a partial proof of the advanced hypotheses. It is important to add, however, that in examining other transect areas throughout the southern Arizona region similar results were identified as those presented in this paper.

Data Collection

In addition to extensive in situ investigations and collections of existing data, a great deal of information was collected expressly for this study. In the summer of 1977 through the spring of 1978 a series of aerial photographic missions were conducted over all the communities/study area transects noted previously. On each of these multi-day, multi-seasonal studies a two 35-mm camera bank system was utilized. One camera was loaded with normal color slide film and the other camera with color infrared slide film. The importance of multi-seasonal aerial photography has been noted before (McCarthy 1972). From the information collected from these oblique photographs it was determined to subcontract for a professional aerial photographic mission during March 1978. The resultant stero 9" x 9" color infrared (#2443) film transparencies were at a scale of 1" = 1000' or 1:1200. The rationale for early color infrared aerial photography and the resulting information relative to the emergence characteristics of plants have been documented (Mc Carthy 1972). Zube (1974) has shown that aerial photographs can be a major data source for regional scenic inventories. The final collection of data consisted of this described color infrared photography and traditional sources (i.e., U.S.G.S. maps, in situ site evaluations, etc.).

Data Analysis

Procedure

It should be remembered that a goal of this research design was to produce two independent measures of both resource complexity and perceived environmental quality. Therefore, the procedures utilized emphasized separate analysis techniques. In order to assess resource complexity advanced students trained in air photo interpretation and land analysis studies were instructed to create overlay maps of landscape units. This method has recently been expanded by work done by Fuller and Fish (1978) Rodiek (1978) and Frondorf et al. (1978). The basic concepts, however, still reflect the ideas of Christian and Steward (1968). In this experiment landscape units were defined by both those traditional measures (i.e., water features, unique attributes, landforms as interpreted by stereo images, etc.) and the color variation noted on the color infrared film as exemplary of vegetational difference. From the combination of these features composite maps of landscape units were delineated.

Superimposed on these final landscape unit composite maps for both the grassland site and the riparian woodland study area was a network grid of the cells that were aligned with the Universal Transverse Mercator system (UTM). Knowing that, at a later time, "on the ground" photos would be taken, a sample cell size of 2 hectares on a side was chosen. The overlay of the UTM system enabled analysis of those grid cells which revealed the most resource complexity as defined by the composite landscape units. From this analysis the 10 most complex cellular units and the 10 least complex units were identified. A total of 20 cells were thus identified for the grassland area and 20 cells for the riparian woodland study area. Figures 1 and 2 illustrate the grid cell overlay superimposed over the composite landscape unit map, with the 20 identified cells shown for each study area.

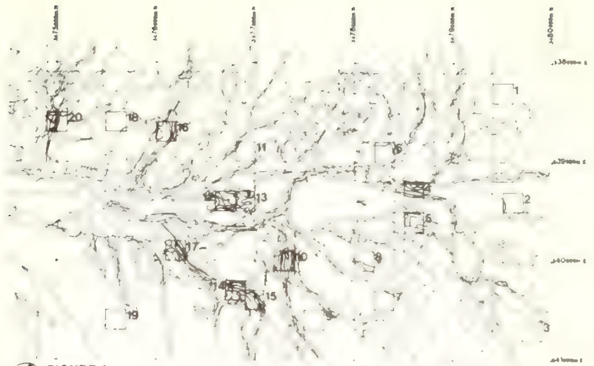

FIGURE 1
SCALE: 1"=3000'-0"

COMPOSITE MAP
GRASSLAND

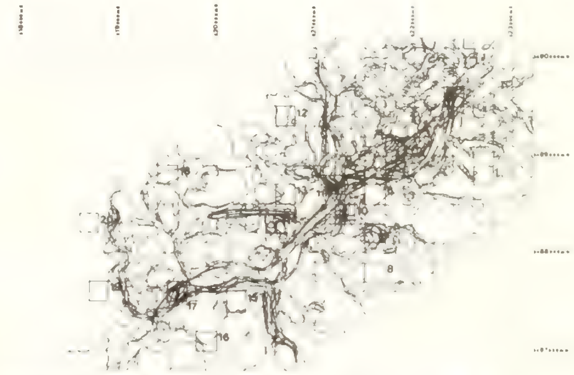

FIGURE 2
SCALE: 1"=3000'-0"

COMPOSITE MAP
RIPARIAN WOODLAND

Maps of the twenty identified cells were given to different students for the purpose of taking photographs "on the ground" to represent the identified cells. Photographs have been shown in other work to be representative of actual site conditions (Daniel and Boster 1976). The students were instructed to identify the center of each cellular unit on the ground using the air photos as an assistance. At each center they were to take a representative photographic print in the same direction so that backgrounds would be similar. All on the ground photographs were taken in March of 1979 to correspond with the color infrared aerial photographic transparencies taken in March of 1978. The resulting slides and photographs would be used for later perception analysis. That analysis and mode of presentation are described in the following sections. The entire procedure can be represented by figures 1 through 6. Figures 1 and 2 are the composite landscape unit maps for both of the study areas. Figures 3* and 4* are taken from the color-infrared transparancies that were used as a basic data source for the study. In both figures 3* and 4*, specific cellular units are identified that can be examined relative to the earlier composite maps. Figures 5* and 6* illustrate cellular units as illustrated in both the composite maps and the color-infrared photography (i.e., cellular unit #5 grassland, #11 riparian woodland).

Subjects

The subjects used to view the "on the ground photographs" were varied in their background. They (N-60) were drawn from graduate students in resource studies-related disciplines at the University of Arizona and from citizen participants within the Tucson, Arizona, community.

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*See color illustration on page 389.

Mode of Presentation and Analysis Technique

The experiments were carried out in small classrooms and home settings. For each area the respondents were asked to rank order a series of 13 photographic prints. The number 13 was arbitrarily selected by the author as a reasonable number to ask respondents to rank order. A random selection of cells was selected from the possible twenty cells to represent the thirteen utilized photographs. The respondents were not informed of any of the previous work relative to complexity that had been undertaken. In each test and subsequent iteration respondents were asked to rank order the photographs (from best to worst) on the basis of perceived environmental quality and visual interest.

Consensus on the rank order of each image relative to its respective study area was determined through a delphi process. Delphi analysis elicits and refines opinion through iterative analysis (Helmer and Rescher 1959, and Dalkey et al. 1972). In none of the experiments was it necessary to go beyond two iterations of testing before the author was satisfied with the expressed convergence. Measures of central tendency (the median) and dispersion (upper and lower quartiles) were produced with this technique as a result of all the respondents inputs.

RESULTS AND DISCUSSION

As a concept, the notions of complexity, diversity and variety have received considerable support as a measure of environmental quality and a means of designing and planning. Greenbie (1976) has recently advanced a planning approach based on an ethological recognition of diversity. In a similar manner a number of ecologists beginning with Margalef (1963) have long supported a "diversity - stability" argument relative to a perceived "good" for various ecosystems. Two of the more recent reviews of the ecological diversity concept are those advanced by Goodman (1975) and Ehrenfeld (1978). In addition to the theoretical arguments made; a number of measures of diversity exists in the ecological literature. Most such measures are based on information theory such as the work by MacArthur and Wilson (1967). Other techniques have been based on probability (e.g., Hurlbert 1971) or dimensional or distance measures (McIntosh 1976). As described in this paper however, complexity is a term defined as the number of opportunities present. This concept is more in alignment with the argument made by Cherem (1973) on "change dimensions."

In contrast to the positive studies noted above a number of other research efforts have challenged the concept of complexity by alluding to an optimum level of stimulation along a continuum of complexity. (Wohlwill 1968). In particular Wohlwill (1968) suggests that functions of visual exploration follow an inverted "U"-shaped trend illustrating a decline after complexity reached a certain point. The results of the research reported in this paper do not support this contention or the conclusion that increased complexity and increase preference are directly related along a linear ascending continuum. Although Wohlwill's research included both "nonsense symbols" and slides of cultural and natural environments, it is doubtful if a natural environment can become too complex so as to exclude preference Such dissagreement indicates the need for continued research into the concept of complexity and preference for valued landscapes.

The results of the research described here reveal a direct relation between perceived environmental quality and independent measures of resource complexity. The following tabulation for the two study areas illustrates the 1) cell number, 2) final median rank, 3) final lower quartile rank and 4) final upper quartil rank: (all rankings are expressed as 1=best to n = worst).

Grassland study area:

Cell Number	Median Rank	Lower quartile Rank	Upper quartile Rank
1	11	12	10
2	11	11	10
4	1	2	1
5	4	4	2
6	11	12	8
8	7	8	6
9	7	7	5
11	7	8	6
13	6	8	5
14	3	4	2
15	3	3	2
18	9	9	7
20	4	4	3

Riparian Woodland study area:

Cell Number	Median Rank	Lower quartile Rank	Upper quartile Rank
2	2	2	2
3	6	8	6
4	8	9	8
5	4	5	3
6	8	12	7
9	6	8	6
11	2	2	1
12	12	13	9
13	12	13	12

Cell Number	Median Rank	Lower quartile Rank	Upper quartile Rank
14	2	3	2
15	9	10	6
16	12	13	10
19	9	9	7

The figures 1 and 2 should be examined in relation to the above tabulation for ease of understanding. The importance of the statistical construct provided by the delphi analysis is that the researcher sees not only the upper and lower ranking but also both the relative dispersion.

It is tempting to try to relate total number of lines per cellular unit as shown on figures 1 and 2 to a direct one to one ordinal ranking based on environmental quality and visual interest. (i.e., that the single cell exhibiting the most complexity would also be the specific site that is judged by the respondents as having the most environmental quality and visual interest.) The results do not reveal this to be true. However, it can be asserted from the experiments described here (and other on-going research) that all the cells/specific sites with a large amount of resource complexity were also all the areas perceived as having the highest quality.

SUMMARY

This discussion has attempted to begin to validate the hypothesis that variable environments; landscapes exhibiting multiple opportunities, offer the greatest potential for quality experiences. Although the work reported here is preliminary and still ongoing the tentative results suggest that independent measures of resource complexity are positively related to scenes perceived by groups of respondents as possessing a high degree of environmental quality. Although this is not a direct one to one relationship, there is enough consensus that one can assert that areas of high complexity will also be perceived as valued landscapes.

NOTES

1. The research described in this paper was partially supported by a grant entitled "Identifying, Designating and Managing Arizona's Critical and Prime Environments" from the U.S. Department of Agriculture, under the Hatch Act.

2. Certain of the ideas presented here were first presented by the author to the Scenic Resource Task Force of the Heritage Conservation and Recreation Service. Those concepts were later included in the evaluation section of the Task Force report Zube et al. (1978) and later summarized by Pitt (1978). In addition the comments and ideas of graduate students in a class taught by the author for the past three years "Critical/Significant Environments" are interlaced throughout this paper.

3. Earlier versions of this paper were reviewed by H. Cortner, T. Daniel, J. Rodiek and E. Zube. The final paper was reviewed by A. Frondorf, W. Havens and R. Kaplan the author gratefully acknowledges their collective suggestions.

4. K. Noon, B. Ripley and D. Wilson worked very diligently in taking photographs, preparing graphics and related technical activities. The author appreciates their support and creative ideas.

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Perception and Landscape: Conceptions and Misconceptions[1]

Stephen Kaplan[2]

Abstract: The focus here is on a functional approach to landscape aesthetics. People's reactions are viewed in terms of what sense they are able to make of the scene and what interest they are able to find in it. This analysis applies first to the two-dimensional space of the "picture plane," where the assessment is in terms of coherence and complexity.

In addition to this "surface" analysis, there is a rapid and unconscious assessment of what one would experience if one were to proceed "deeper" into the scene. In this way inferences about the nature of the three-dimensional environment lead to conclusions concerning how legible it is likely to be and how much additional information is likely to be provided. These four informational elements -- coherence, complexity, legibility, and mystery -- provide means of assessing landscape quality that are empirically based while at the same time intuitively meaningful.

INTRODUCTION

It would seem that the psychology of perception should have something useful to contribute to landscape aesthetics. Certainly students of landscape aesthetics make assumptions about the nature of perception. While certain of these favorite assumptions are probably false, there was a time when it was not obvious that the psychology of perception had anything better to offer. Fortunately, a number of recent developments sheds considerable light on the significance and functioning of the aesthetic reaction to landscapes.

From the perspective of landscape aesthetics, perhaps the single most salient theme in recent work in perception is what Gibson (1977) has labeled "affordances." An affordance refers to what a perceived object or scene has to offer as far as the individual perceiver is concerned. Perception is viewed as not merely dealing with information about the environment, but at the same time yielding information about what the possibilities are as far as human purposes are concerned. In addition to Gibson's contribution to this topic, this emphasis on the function an object or environment might serve for the perceiver has also appeared in the work of Gregory (1969) and S. Kaplan (1975).

One can go a step farther than the perception of affordances per se. As Charlesworth (1976) has pointed out, a species has not only to be able to recognize the sorts of environments it functions well in, it has to prefer them. Animals have to like the sort of settings in which they thrive. Ideally they would not have to learn such an inclination. It could be costly for an animal to spend years barely subsisting in unsatisfactory environments in order to learn that such environments were in fact unsatisfactory. And to the extent that erroneously choosing certain environments could be a fatal error, such a bias would ideally be innate and immediate. Hence, one can view preference as an outcome of a complex process that includes perceiving things and spaces and reacting in

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terms of their potential usefulness and supportiveness. In this perspective aesthetics must, at least to some degree, reflect the functional appropriateness of spaces and things.

It should be noted, however, that this view of preference as an expression of bias towards adaptively suitable environments has no necessary connection to what is currently functional. What was functional during the evolution of the species is presumably what would be preferred, quite independent of what might be functional today.

SOME COMMENTS ON PREFERENCE

In the context of an evolutionary perspective, it is hardly surprising that human preference would have some relationship to those environments in which survival would be more likely. This context, however, does not appear to be characteristic of discussions of landscape preference. As a matter of fact, a significant number of students of landscape aesthetics views preference with alarm, or at the very least, distaste. There are many who feel that preference judgments are bound to be arbitrary, idiosyncratic at best, and perhaps even random. In part the distrust of preference judgments probably stems from the fear that aesthetics will be debased by stooping to a popular consensus. Hidden in this fear is a profound irony. It implies that there is no basic consistency, no underlying pattern characteristic of preference judgments. Without such an underlying basis, however, aesthetics becomes trivialized. If aesthetics is not an expression of some basic and underlying aspect of the human mind, then it is hard to see why it is of more than passing significance. It is reduced to mere decoration as opposed to being something with pervasive importance. In the concern to preserve aesthetics untarnished, it makes it at the same time inconsequential.

If indeed aesthetics had no deep underlying significance for our species, then one would expect preference judgments to vary randomly from one person to the next. But this is not a matter of opinion; it is an empirically testable hypothesis. This conjecture, as well as the others implicit in the rejection of preference is not only testable; it has been tested many times. These fears receive no support from many studies. (For a discussion of a number of such studies see S. Kaplan 1979.) Preference judgments are neither random nor highly idiosyncratic. Neither are they debasing; many of the rules that preference follows turn out to have correlates in the classic aesthetic and landscape architecture literature. At the same time their divergences are thought-provoking and instructive.

To summarize the ground covered so far, recent work on perception views the perceptual process as inextricably connected with human purposes, and perhaps with human preferences as well. Preference, in turn, is a far better-behaved measure than is often feared. The remainder of the paper is based on the premise that preference judgments are not antithetical to aesthetics. Rather, they are seen as providing a powerful tool for understanding the patterns underlying what we consider aesthetic. Such judgments may also point to the underlying significance of the aesthetic in the larger human scheme of things.

MAKING SENSE AND INVOLVEMENT

If people's reactions to things and spaces depend on people's purposes, then understanding preference requires that we first understand what these purposes are. Since different people pursue different purposes, and since the same individual will pursue different purposes at different times, an analysis in terms of purpose might appear to be at best unpromising. Fortunately for both science and practice, however, human purposes are by no means totally scattered and idiosyncratic. In fact our research on preference has over the years repeatedly pointed to two underlying purposes which people are concerned with throughout their waking hours. These two purposes probably had an important impact on the long-term survival potential of the individual. Their pervasive influence seems appropriate since they are necessarily vital to any specific purposes an individual may choose to pursue.

We have come to call these persisting purposes "making sense" and "involvement" (R. Kaplan 1977). Making sense refers to the concern to comprehend, to keep one's bearings, to understand what is going on in the immediate here and now, and often in some larger world as well. Involvement refers to the concern to figure out, to learn, to be stimulated. At first glance these two purposes may seem to be contradictory, or at least at opposite ends of a continuum. But upon closer examination this turns out to be a misconception. Certainly there are environments that one can comprehend and at the same time be stimulated by. Likewise, there are environments that offer neither possibility. In fact, all combinations are possible; knowing that an environment makes sense tells one nothing about whether it will be involving or not.

While our realization of the centrality of these two purposes arose in the context of research on preference, there are sound theoretical grounds for believing that they would be necessary to the survival of an information-based organism. There are also parallels in the psychological literature -- order, security, closure, and the like on the one hand, and curiosity, challenge, stimulation, and so on, on the other. (Limitations of space permit only a brief mention of these themes here; for a more extensive discussion see Kaplan and Kaplan 1978).

If making sense and involvement are indeed pervasive purposes for humans, then environments that support these purposes should be preferred. "Support" here refers to whatever an environment might afford that makes that particular purpose more likely to be pursued to a successful conclusion. For making sense this refers to the perceived structure of the environment. It takes in anything that would make the environment easier to create a map of, easier to characterize, to summarize to oneself. It involves those affordances that increase one's sense of comprehension.

For involvement, on the other hand, the supportive environment is one rich in possibility. In a sense, the affordances for involvement entail the raw materials for thinking about and coming to understand. The issue here is having what is required to be challenged, to have to call on one's capacities in order to process the information successfully. Thus a poem or a landscape that is "simple-minded" or "obvious" fails to offer affordance for involvement. (It should be noted that the "raw material" that challenges one's capacities need not actually be present; it constitutes an effective challenge even if it is only implied or suggested.)

THE VISUAL ARRAY

In reacting to the visual environment, people seem to relate to the information they pick up in two quite different ways. They react both to the visual array, the two-dimensional pattern, as if the environment in front of them were a flat picture, as well as to the three-dimensional pattern of space that unfolds before them. The idea of the visual array is easiest to think of in terms of a photograph of any given landscape. The pattern of light and dark on the photograph, the organization of this "picture plane," constitutes the basis of this level of analysis.

As the surface of a photograph can have much or little to look at, scenes can vary in involvement at this level of analysis. Comparably, the pattern of information on the surface of a photograph can be easier or harder to organize, constituting the "making sense" aspect of the visual array. Let us examine each of these components in somewhat greater detail.

Complexity is the "involvement" component at this surface level of analysis. Perhaps more appropriately referred to as "diversity" or "richness," this component was at one time thought to be the sole or at least the primary determinant of aesthetic reactions in general. Loosely speaking it reflects how much is "going on" in a particular scene, how much there is to look at. If there is very little going on -- as, for example, a scene consisting of an undifferentiated open field with horizon in the background -- then preference is likely to be low.

Coherence is the "making sense" component at this surface level of analysis. It includes those factors which make the picture plane easier to organize, to comprehend, to structure. Coherence is strengthened by anything which makes it easier to organize the patterns of light and dark into a manageable number of major objects and/or areas. These include repeated elements and smooth textures that identify a "region" or area of the picture plane. Readily identifiable components aid in giving a sense of coherence. It is also important that a change in texture or brightness in the visual array is associated with something important going on in the scene. In other words, something that draws one's attention within the scene should turn out to be an important object or a boundary between regions or some other significant property. If what draws one's attention and what is worth looking at turn out to be different, then the scene lacks coherence.

People can only hold a certain amount of information in what is called their "working memory" at one time. Research on this phenomenon suggests that this limit in capacity is best understood in terms of a certain number of major units of information or "chunks." Thus, rather than being able to remember a certain number of individual details or facts, people seem to be able to hold on to a few distinct larger groupings of information. The current evidence suggests that most people are able to hold approximately five such chunks or units in their working memory at once (Mandler 1967).

It follows from this that anything in the scene which helps divide it into approximately five major units will aid the comprehension process. The various factors that contribute to coherence all tend to do this. The greater the complexity of a scene, the more structure is required to organize it in this way, or in other words, for it to be coherent as well.

THREE-DIMENSIONAL SPACE

The analysis at the level of the visual array, of the picture plane itself, is important to the viewer but at the same time limited. Landscapes are three-dimensional configurations and it was in that third dimension that our ancestors functioned or failed to function, survived or perished. It is hardly surprising that people automatically interpret photographs of the environment in terms of the third dimension as well.

As we might expect given the evolutionary importance of space, humans are highly effective at perceiving depth. Perhaps the most central issue in analyzing a scene involves the three-dimensional space and its implications. As Appleton (1975) points out, there are implications both in terms of informational opportunities and in terms of informational dangers. The informational opportunities he calls "prospect." This idea of being able to gather new information has a kinship to the involvement side of our framework. In particular the opportunity to gather new information in the context of an inferred space is what we have come to call "mystery."

Mystery. One of the most striking aspects of people's reaction to landscapes that suggests a three-dimensional interpretation is their preference for scenes where it appears as if one could see more if one were to "walk into" the scene a ways. Strong as this "involvement" component of the spatial interpretation has been, it has been frustratingly difficult to find a name for. We have decided on mystery, a term long ago used in the context of landscape architecture to refer to an essentially similar idea (Hubbard and Kimball 1917).

Some investigators in this area have assumed that we were referring to surprise or novelty. But "novelty" implies that one is perceiving something new, and a scene high in mystery may have nothing new present (and conversely, a novel object present in the scene in no way assures mystery.) Likewise "surprise" implies the presence of something unexpected. Mystery involves not the presence of new information, but its promise Mystery embodies the attraction of the bend in the road, the view partially obscured by foliage, the temptation to follow the path, "just a little farther." While the "promise of more information" captures the essential flavor of this concept, there is actually more to it than that.

Scenes high in mystery are characterize by continuity; there is a connection between what is seen and what is anticipated. While there is indeed the suggestion of new information, the character of that new informatio is implied by the information that is available. Not only is the degree of novelty limited in this way; there is also a sense of control, a sense that the rate of exposure to novelty is at the discretion of the viewer. A scene high in mystery is one in which one could learn more if one were to proceed furth into the scene. Thus one's rate and direction of travel would serve to limit the rate at which new information must be dealt with. For a creature readily bored with the familia and yet fearful of the strange, such an arrangement must be close to ideal.

Another area of potential confusion should perhaps be mentioned. "Mystery" to some people connotes the ambiguous, even the incoherent or impossible to understand. Whil it is in some way true that anything that makes no sense is mysterious, the term is intended in a far more limited sense. Admittedly it implies uncertainty. But here the uncertainty is thoroughly constrained and bounded. It is of a limited degree and its rate of introduction is under control. It is by no means beyond comprehension; rather it is possible to anticipate to a reasonable degree. Mystery arouses curiosity. What it evokes is not a blank state of mind but a mind focused on a variety of possibilities, of hypotheses of what might be coming next. It may be the very opportunity to anticipate several possible alternatives that makes mystery so fascinating and mindfilling. The human capacity to respond to suggestion is profound.

Legibility. The other aspect of landscape stressed by Appleton concerns safety in the context of space. While he terms this component "refuge," emphasizing being able to see without being seen, from an informational perspective safety encompasses considerably more than this. This broad conception of safety closely parallels the "making sense" side of our framework; we have chosen the term "legibility" to refer to the possibility of making sense within a three-dimensional space.

Like mystery, legibility entails a promise, a prediction, but in this case not of the opportunity to learn but to function. It is concerned with interpreting the space, with finding one's way, and not trivially, with finding one's way back. Hence it deals with the structuring of space, with its differentiation, with its readability. It is like coherence but instead of dealing with the organization of the "picture plane" it deals with the organization of the ground plane, of the space that extends out from the foreground to the horizon.

A highly legible scene is one that is easy to oversee and to form a cognitive map of. Hence legibility is greater when there is considerable apparent depth and a well-defined space. Smooth textures aid in this and so too do distinctive elements well distributed throughout the space that can serve as landmarks. Another aspect of legibility involves the ease with which one can perceive the space as divided up into subareas or regions. There is a strong parallel here to what makes a scene coherent, but coherence differs in referring to the organization of the visual array rather than to the three-dimensional space. Coherence concerns the conditions for perceiving while legibility concerns the conditions for moving within the space.

It must be emphasized that the interpretation of a scene in three dimensions is, like the analysis of the visual array or "picture plane," an automatic and generally nonconscious process. People tend not to know that they are doing this. It characteristically happens very rapidly and effortlessly. Although the basis for hypothesizing such a process comes from data on preference, on the other hand this is precisely the sort of processing of affordances, of what the environment offers, that one would expect of a far-ranging, spatially-oriented species.

Overview of Preference Matrix

These two large domains of human preference, considered in terms of the visual array and in terms of three-dimensional space, can be summarized by a 2 x 2 matrix:

Level of Interpretation	Making Sense	Involvement
The Visual Array	Coherence	Complexity
Three-Dimensional Space	Legibility	Mystery

The entries in the table should be thought of as broad concepts, each subsuming a variety of different components. Some of these specific components, in turn, influence more than one cell in the matrix. Smooth textures, for example, tend to enhance both coherence and legibility. Comparably the factors that tend to make a scene appear to have greater depth enhance both legibility and mystery.

Although both the surface and the three-dimensional levels of analysis are represented in the matrix, these two levels may not have comparable weight. While it is necessary for a scene to have at least a modicum of coherence and a modicum of complexity to be preferred, high values of these components do not necessarily lead to high preference. By contrast, legibility and especially mystery seem to influence preference throughout their entire range.

It should be reiterated in the context of the table that making sense and involvement are independent aspects of a scene. While a scene of high complexity can lack coherence, it can also, like the Taj Mahal, possess a great deal of coherence. Likewise the presence of high legibility as in a scene with a well-structured space, does not prevent the partial obscuring and opportunity for exploration that is characteristic of a scene rated high in mystery. In more general terms, one can think of these issues from the perspective of the kinds of information required for making sense and the kinds of information that enhance involvement.

On the making sense side of the ledger, structure is required in a scene both to comprehend what is where in the visual array and to interpret the larger spatial configuration. At the same time there may be few different things in the scene (low complexity) or many. The more complex scene increases the possibilities for what one could look at, and hence, in a sense, increases the uncertainty. But the structure is not thereby decreased.

Likewise there may be much suggested or implied by the scene as being available but beyond one's present view. Here too, there is an increase in uncertainty that in no way contradicts or undermines whatever structure the scene possesses.

Readers familiar with an earlier version of this matrix (S. Kaplan 1975) might find the current configuration a bit disorienting at first glance. Note, however, that three of the four constructs (complexity, coherence, and mystery) have remained the same and have the same relationship to each other. The major additions, the making sense/involvement distinction and the two levels of interpretation, have a number of advantages over their predecessors, both intuitively and theoretically.

SOME COMMON MISCONCEPTIONS

Idiosyncracy in Perception

There is a great deal of concern and confusion over the problem of idiosyncracy in perception; it becomes particularly acute when the issue of preference is included. After all, everyone knows how much taste differs from one person to the next. And if taste is purely personal, or if not personal, at the whim of culture, then decisions on preference will be at best arbitrary.

This concern, while understandable enough, is misguided. Perception, and preference for that matter, are no more variable than any other aspect of human experience and human behavior. As with everything else there is regularity and there is variability. As with anything else identifying and understanding that regularity is crucial to appropriate policy and decision-making. It has been the purpose of this paper to identify some of these regularities and to suggest some ways in which they might be understood.

While idiosyncracy per se turns out to be not that much of a problem either theoretically or empirically, some of the ways proposed to deal with it have created new problems that are rather more serious. One reaction involves relegating all the variability to some post-perceptual process. Thus it is asserted that "perception is the same for all people while interpretations vary." The difficulty with this solution is, as we have seen, that perception and interpretatio are inseparable. The perceptual process is itself influenced by all those cultural, experiential, and individual factors that ar supposed to underlie interpretation.

A similar approach has been to create variables for people to judge that are "objective," so as to get around the subjectivity of preference. Sometimes the "objectivity" is achieved by having people rate scenes in terms of landscape features rather than in terms of preference. Agreement usin such a procedure has not, however, been particularly impressive (R. Kaplan 1975). Thi is perhaps not surprising. People make judgments of preference quickly and easily. By contrast, judgment of the presence or absenc of certain landscape features may seem to many people to be unnatural or forced. Unlike preference, it is not a judgment they make frequently and intuitively.

There is thus the temptation to dispens with ordinary people altogether, to rely on selected judges to make the ratings. And often what they are asked to do is to make "assessments of aesthetics" rather than to rate the scenes for preference. From a psychological perspective the distinction between these two kinds of judgments is difficult to justify.

Although perceptions are not all the same, there are some remarkable communalities perhaps in part because of our common evolutionary heritage. And while there are indeed certain cultural differences, these may invol differential emphasis on the components of preference discussed earlier. Some of the most reliable differences between groups as far as preference is concerned turn out, interestingly enough, to be between experts and everyone else (R. Kaplan 1973; Anderson 1978). This makes good sense psychologically. There is now substantial evidence that experts perceive differently than do other people (S. Kaplan 1977; Posner 1973). This is restricted to their area of expertise and in fact constitutes an important facet of their expertise. But the fact remains that experts, often without realizing it, do not see their part of the world the way anyone else sees it. While experts are invaluable resources when used appropriately, they are a dubious source of "objective" judgment as to what people care about in the landscape.

What is REALLY Important in Landscape

There have been numerous efforts to

identify the crucial aspects of the human reaction to landscape, to get to the heart of the matter, as it were. One such approach is both impressive in its directness and disturbing in its implications. This approach is based on ferreting out the unique. It is argued that the more unusual the scenery, the more valuable it is. This is essentially an economic argument, relying exclusively on scarcity. While it is undoubtedly true in some limited sense, it is equally false in a larger sense and certainly a caricature of the multiplicity of factors influencing preference.

People's reaction to nature is an example of a noneconomic need (see Hendee and Stankey 1973, Kaplan and Kaplan 1978). It is not something to be exchanged for something else, but an intrinsic reaction. People value even rather common instances of nature (Kaplan, Kaplan and Wendt 1972, R. Kaplan 1978). At the same time certain rare, nonnatural elements (a unique statue, for example) are not valued at all.

There is a sense in which uniqueness is valued. That is when a place has a distinctiveness, a "sense of place," that makes it possible to know where one is whenever one visits that place. This is a rather special meaning of "uniqueness" that has little relation to the visual scarcity interpretation.

Another derivative of the uniqueness idea that might be worth studying is the uniqueness of a place in terms of access. Thus the only park one can get to for lunch within walking distance of downtown is unique in an important way although not in the traditional sense of "unique content."

Another influential scheme for landscape analysis focuses on the four factors of form, line, color, and texture. This approach conflicts with the realities of human perception in a number of respects.

First, these properties tend to emphasize the two-dimensional picture plane. Clearly this is not irrelevant to landscapes; they too can be analyzed as a visual array. But much more importantly a landscape is a three-dimensional space. Since a substantial portion of the human response to landscape turns out to depend upon the sort of space involved, and the way the individual envisions locomoting in that space, any approach which emphasizes the picture plane is bound to miss much of what matters most to people in landscapes.

Secondly, these four factors do not even provide an adequate sampling of the key properties of the picture plane. They are heavily weighted toward visual contours and toward discreteness. Recent work on visual functioning suggests that a far more global kind of processing may be at least as important, especially as far as spaces to walk in are concerned. An ancient component of the human visual system that has been referred to as the "location processing system" (S. Kaplan 1970) is so closely tied to the capacity to wander through three-dimensional space that it has also been identified as the system that makes possible "ambient vision" (Trevarthen 1978). For this system the size and rough spatial arrangement of elements on the picture plane interact with texture to provide a global overview of the situation. To the extent that this system plays a role in preference, it will be necessary to take a fresh look at the factors that are most salient at the level of the picture plane.

This paper has dealt with a variety of factors that play a role in human preference for landscapes. It has also attempted to deal with some widely held misconceptions about preference and about perception as well. But the purpose of the paper is not to propose a new set of factors to take the place of a traditional set. Rather the purpose is to describe a different way of thinking about people, a new way of conceptualizing what goes on in people's heads when they react to a landscape or other environment. What I would like to propose is a functional approach, a view of what people are trying to do. When people view a landscape they are making a judgment, however intuitive and unconscious this process may be. This judgment concerns the sorts of experiences they would have, the ease of locomoting, of moving, of exploring, in a word of functioning, in the environment they are viewing.

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The Social Value of English Landscapes[1]

Edmund C. Penning-Rowsell[2]

Abstract: Qualitative assessments of landscape resources can best be approached through direct measurement of landscape perceptions. Results from a survey of one District in Hertfordshire, England, show this approach not only to be viable but also to yield much information relevant to plans for landscape improvement and protection. Consensus was high and the socio-economic variables generally had little effect on evaluations. Residential location was important in affecting landscape perceptions, resulting in an urban/rural variation in results. For detailed surveys of landscape resources prior to planned landscape change this public-participation approach to landscape resources is recommended in preference to methods based on statistical prediction or professional judgment alone.

INTRODUCTION: THE EVOLUTION OF LANDSCAPE ASSESSMENT METHODS IN BRITAIN AND THE RATIONALE FOR PREFERENCE SURVEYS

In Britain the scenic quality of rural areas has been seen by both planners and the public as a valuable attribute to conserve. However, agreed criteria on which to base measurement of these scenic resources is absent and in its place there has developed a large number of different techniques each aimed at predicting landscape preferences from measured landscape characteristics (Penning-Rowsell 1973b, 1974 and 1975, Dunn 1974, Robinson et al.1976).

The Evolution of Landscape Assessment Methods

Three main themes run through British landscape assessment research in the last ten years. The measurement of landscape quality has been approached, firstly, by direct measurement by the planners or landscape architects concerned with drawing up plans for landscape protection or enhancement, mainly using simply intuition aided perhaps by some sort of checklist or variable weighting device to record and assign ratings to sites or tracts based on supposed contributions to attractiveness of individual landscape components. This approach was adopted by many County planning, departments in the late 1960's and early 1970's and is exemplified by the work of Hampshire County Council (1968) based on a method devised by Hebblethwaite (1970) and adapted by other researchers (Tandy 1971).

The second approach to landscape resource assessment in Britain has used complex predictive statistical models such as that developed by the University of Manchester, England (Robinson et al. 1976). Here sample qualitative assessments by a panel of professionals for parts of a study region are extrapolated to the remaining locations using multiple regression techniques based on measured independent variables of selected landscape elements for the whole region. Such predictions have been seen as useful owing to the high correlations, generally in the order of r = 0.75, between these landscape elements and the scores allocated to the sample areas by the professional panels.

The third approach to landscape evaluation, and hitherto still in its infancy, has been the assessment of landscape preferences of members of the public for landscape quality: the public preference approach. This direction has been followed in limited ways by

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Penning-Rowsell(1973a), Clamp (1975) and Dunn (1976) in Britain and in parallel by Zube (1973) and others (Zube, Brush and Fabos 1975) in the United States.

An Explanation of the Evolution of Methods

In part these three approaches have evolved from one another. Initial distrust of apparently over-subjective intuitive approaches led to the developments of the supposedly more objective statistical techniques in the search for methods of landscape evaluation which professionals could use without fear of attracting criticism of influencing the results by their own feelings - an attempt to remove the subjectivity from resource assessments despite the obviously subjective nature of landscape quality itself. The public preference approach is now growing out of a dissatisfaction with the statistical methods of landscape quality prediction since these now appear unnecessarily complex and simply hide the important subjectivity behind a facade of statistical manipulation.

The Rationale for the Public Preference Approach

The rationale of the public preference approach to landscape evaluation or assessment lies in the inherent complexity of the concept or construct of landscape quality and value (Lazersfeld 1958). To derive indicators and indices to operationalize this construct we need to identify the different facets that comprise the construct, including the historical associations and familiarity. All these different facets of landscape appreciation lead to different assessments of the same scenic resource by different people at different times. Landscape value is therefore part of a changing social reaction to the environment in which we live, and we cannot quantify this reaction except in terms of what people view as historically important, aesthetically pleasing or safely familiar at any one time. To rely on surrogates is dangerous when we know so little about the true essence of the appeal of landscape (Appleton 1975); greater validity than can ever be possible with surrogates comes from direct social appraisals of landscape as a social resource. Furthermore while legislation in Britain does not demand publicly-based environmental appraisals as reported for the United States (Schomaker 1978), nevertheless landscape planning will fit more comfortably with social expectations if proper public inputs have been employed (Penning-Rowsell 1974).

THE DEVELOPMENT OF A METHODOLOGY FOR THE ASSESSMENT OF THE SOCIAL VALUE OF LANDSCAPES

Virtually all previous attempts to incorporate public preferences into landscape assessment methods have either used photograph or used select panels of professionals (Dunn 1976, Robinson et al.1976, Shafer 1969, Fines 1968, Zube et al. 1974). This approach was explicitly rejected in this research[3] because the author distrusted the use of photographs as not being sufficiently close to reality and also the use of professional or otherwise selected panels was avoided as possibly introducing bias on the basis that "professionals can no longer base decisions solely on what they deem best, ignoring public input" (Schomaker 1978). Instead the major aim was to elicit the responses to rural landscape of ordinary members of the public while at the same time aiming at developing a technique that was simple, cheap, rapid and effective because otherwise planning departments would not be willing to employ the resulting methods.

To link the landscape assessment even more clearly into a planning framework two further constraints were imposed. Firstly, th result of the survey was to be a map of perceived landscape quality based on the public preference surveys, as being the result requir by the planner (although obviously in itself a gross over-simplification). Secondly, it was decided that the area covered should be th whole of an administrative rather than a landscape unit: to select a river basin or mountain range for study facilitates the asses ment of landscape character and quality but no the planning process taking off from that assessment.

Pilot Assessment of Attitude-Measurement Techniques

The approach to developing techniques for assessing the public's view of landscape quality involved two stages. Initially a pilot survey reviewed many attitude-assessment techniques and tested several through a small survey comprising 23 interviews (Penning-Rowsel 1979). Subsequently a main survey applied the techniques found most successful in the pilot work to a much larger area using a survey involving 540 interviews.

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[3] The research described in this paper was carried out under a $10,000 grant from the Social Science Research Council and is fully reported in Penning-Rowsell et al.(1977) available from Middlesex Polytechnic, Queensway Enfield, England.

The pilot survey tested the use of a wide range of attitude-assessment techniques including attitude statements and semantic differential rating scales (Osgood et al. 1957, Lowenthal and Riel 1972), adjective checklists (Craik 1970) and cued and free response. These techniques were all incorporated into two questionnaires, designed to test these methods in different ways, which were used to interview respondents in their own homes. These methods were all structured to elucidate evaluative, potency and detailed landscape judgments from those members of the public interviewed. The main conclusion of the pilot survey was that the basic approach was successful and that it was possible to obtain firm and apparently rational assessments of landscape quality from members of the public. However some of the techniques were more successful than others when applied to this complex perception situation. Both cued and free response were successful in gauging the degree of familiarity of respondents with local landscapes as well as revealing some previously not considered reasons for landscape appreciation such as this landscape familarity and even ordinariness. The adjective checklists with 40 adjectives produced useful descriptions of landscape areas. However semantic differentials used in this survey were most successful at obtaining the comparative information essential for landscape evaluation, although the 15 scales used were far too many and repetitive.

Main Survey Methods

The questionnaires used in the pilot survey to incorporate into a single questionnaire a simplified semantic differential approach using a single preference rating scale of "Attractiveness" which had been found the most efficient landscape descriptor in the pilot tests. The choice of a single simple scale was again made in recognition of the major aim of arriving at a simple evaluative technique for planning department use. Ranking of landscape areas was also incorporated to guard against excessive use of identical rating positions. The cued response sections were retained to obtain information on respondents' familiarity with landscapes in question, with a view to subsequent weighting responses to reduce the influence of those with low familiarity ratings in the final "consensus" evaluations. Also included were questions to elucidate reasons for evaluations with which to attempt to gauge the degree of rationality or randomness of the assessments, as well as investigating attitudes to distant landscapes since the pilot survey had shown the tendency for respondents to over-praise their immediate locality.

In the main survey 540 respondents were sampled from a population of 120,000 in the District of Dacorum in Hertfordshire (fig. 1), using electoral registers to obtain the sample. Each person was interviewed, in their homes, about the landscape of their immediate locality and of the region, divided into landscape tracts designed to isolate areas of homogenous landscape based on statistical cluster analysis of landscape elements. Interviewers reported that respondents both know local landscapes well and that they made firm evaluations using the preference rating scale although there were inevitable interviewing problems particularly concerning the definition of degrees of "Attractivenes." As in virtually any household survey there was sample bias in favour of middle-class housewives at the expense of working-class males but subsequent analysis showed that these socio-economic factors do not appear to affect landscape perceptions.

SURVEY RESULTS: THE CONSENSUS LANDSCAPE EVALUATION OF THE STUDY AREA AND FACTORS AFFECTING EVALUATIONS

The main survey was arranged such that in each community or parish about 30 persons were interviewed and from these sub-samples consensus evaluations were derived using the modal or most popular preference rating scale position elected by these respondents. Each of these modal evaluations then forms one element in the map shown as figure 1 to produce a generalized (and almost certainly overgeneralized evaluation of the study District.

The 73 landscape units - each corresponding to a part of a parish in which the 30 or so interviews had been conducted - were rated by the interviewees in a range from "Extremely Attractive" to "Unattractive;" none was rated overall as "Very Unattractive" or "Extremely Unattractive." The "Unattractive" units comprise certain village center areas and a disused airfield while the "Very Attractive" areas form a band to the north of the study area following the Chiltern Hills, the exception being one locality in the south comprising a well-known "beauty-spot" within the Chilterns Area of Outstanding Natural Beauty (a statutory designation similar but at a lower level to National Parks).

Consensus With The Most Popular Evaluations

Public landscape evaluations will only be valid and useful if the degree of consensus is high. The extent of the actual consensus can be masked by the process of taking the modal evaluation, in that there can be bi-modal or near bi-modal distributions of responses only one result from which can be taken. Nevertheless the consensus overall was high, ranging from 76 percent in one community to a low of 40 percent in another (where there was indeed a "split-vote" bi-modal distribution). The overall distribution of consensus rates is given in figure 2 showing that most of the 73 landscape units attracted a majority of respondents agreeing to the most popular or modal evaluation. Greater perceived attractiveness does not appear to promote greater or lesser consensus, nor is high consensus related to those landscape areas generally most familiar; indeed the variation in consensus rates is still largely unexplained.

General And Detailed Reasons For Evaluations

Respondents were asked the reasons for evaluations given and, in addition to familiarity which shows a strong correlation with evaluation such that those areas most familiar are rated most highly and vice versa, the use of land and landscapes appears important in affecting evaluations. In general, aspects of rurality such as the presence of worked agricultural land and of woodland and the presence of water were given as the reasons for high evaluations, along with the incidence of views and certain "urbanizing" elements such as vernacular villages. Low evaluations such as "Unattractive" and "Very Unattractive" were associated with unfavorable characteristics of farmland, such as poor access and intrusive farm buildings, but mainly these low evaluations were related to urban intrusion into the countryside especially village centers perceived as "scruffy" and eyesores such as the disused airfield.

More complex detailed reasons for low evaluations, given this time by individuals rather than the groups as a whole, included "Tatty - unplanned development" and the "Noise from roadways," the appearance of the landscapes in these circumstances seems secondary to other less obvious landscape factors. Detailed reasons for high evaluations included "Quietness" and "One can get out of sight of houses" and "Grandeur" in addition to repeated mentions of trees, woodland and "Nice old lanes."

We can see in these reasons for evaluatio both a coherent structure and a vindication of the admittedly oversimplyfying preference rati scale. The areas designated with different levels of attractiveness both have contrasting perceived characteristics and the public respo to these in different ways such that different evaluations within the samples genuinely refle different feelings towards the same landscape and its features. From this rational relationship between landscape characteristics and its evaluation we can infer that the preference rating scale of landscape value is not arbitra or random but coherent and furthermore the extent of agreement of the reasons for evaluations amongst respondents shows that the map produced (fig. 1) is a genuine representation, albeit generalized of perceived quality of th landscape of the areas.

The complications around the general assessment are themselves revealing. For example, urban dwellers tend to over-praise rural areas compared with their rural colleague The latter reserve the high praise given by urban residents to large areas of landscape fo the few select areas or "beauty spots" perhaps more familiar to the rural dweller. Again, those living in one rural community tend to over-praise their immediate locality compared with assessments of the same landscape from those living in neighbouring rural communities, who perhaps have a more detached view.

Landscape Perception And Socio-Economic Factors

There appears to be no relationship between social class and landscape evaluations; higher socio-economic groups do give marginally higher evaluations -- or are more free with the use of the higher evaluative points on the preference rating scale -- but this trend is not statistically significant. Nor is there a significant relationship between the reasons given for the evaluations and socio-economic characteristics of respondents, as one might perhaps expect. The lower social classes were less forthcoming with responses but when these responses were obtained they were not significantly different from those of other social groups.

In contrast, landscape evaluations appear related to respondent's age such that the older interviewees in general give higher evaluations, presumably reflecting their greater familiarity with the landscapes in question. Female respondents tended to report less familiarity with their local landscapes but landscape evaluations did not differ between the sexes. What did appear to affect evaluations is the

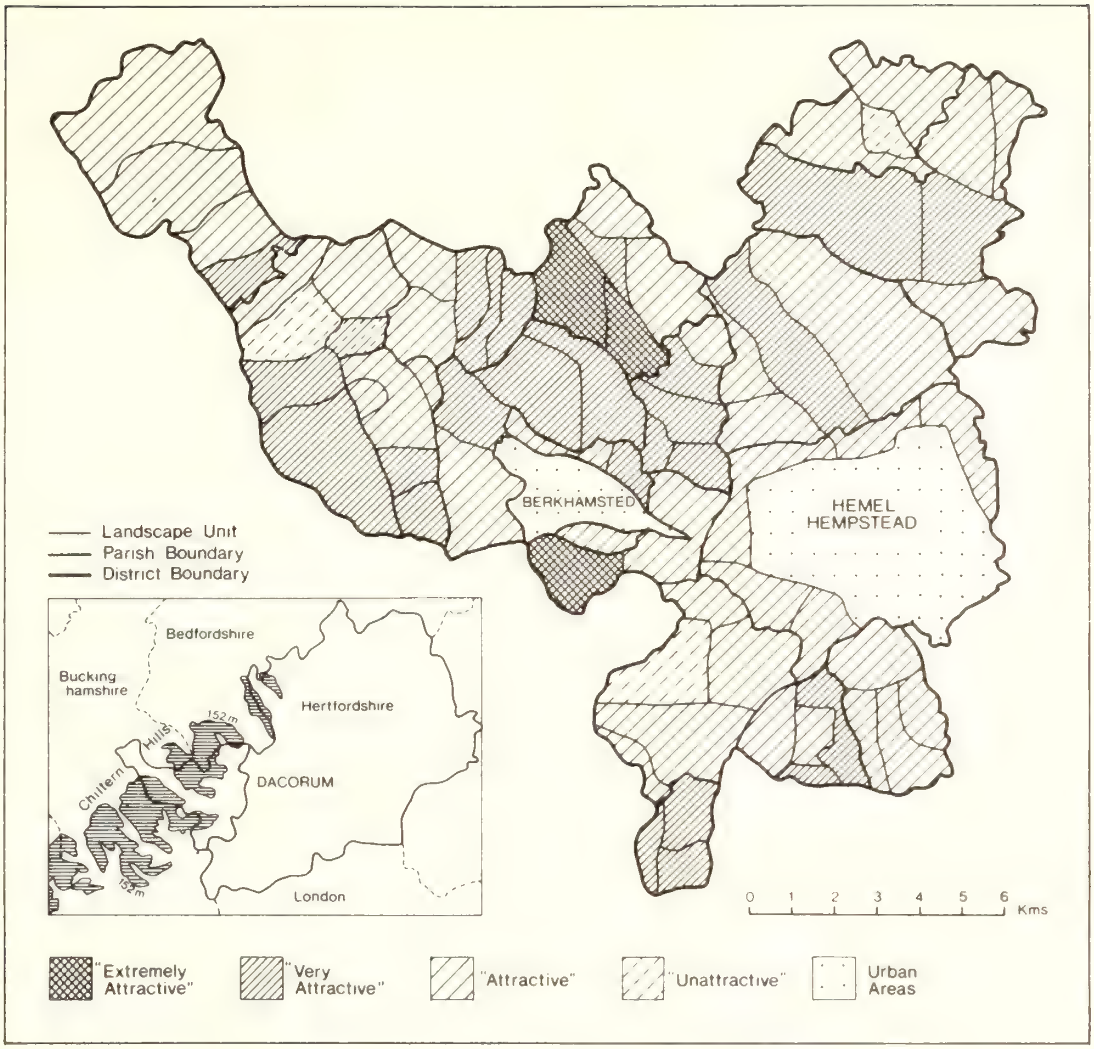

Figure 1 - Landscape assessment of Dacorum District, England.

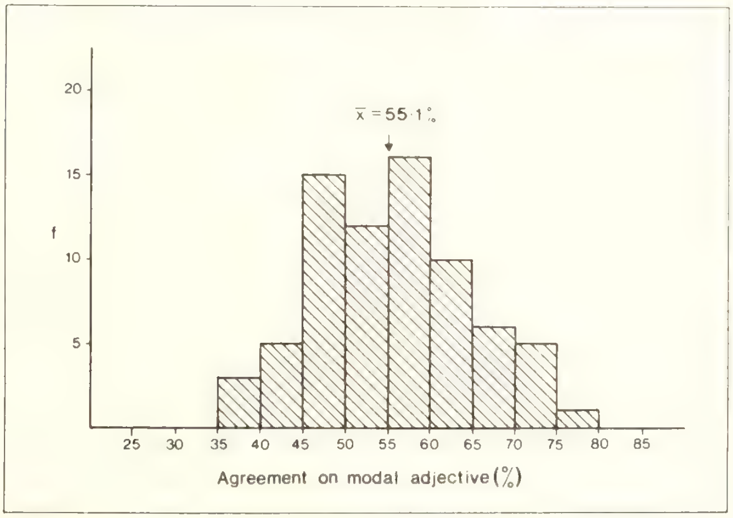

Figure 2 - The distribution of modal percentages of respondents.

childhood place of residence of respondents, with those born and bred in the same rural community tending to praise local landscape attractiveness, perhaps in order to justify their decision to locate in that area. The essence of these relationships is that "country people" are more familiar with the landscapes of their current home area but are not likely to give higher evaluations than their town bred neighbors now living in the same rural community. However those "country people" who have lived all their lives in the same community show the greater familiarity with their local landscapes, as one would expect, yet tend to give lower than average evaluations. Familiarity here clearly leads to relative "contempt" in contrast to the general relationship of greater familiarity leading to greater appreciation.

CONCLUSIONS: LANDSCAPE - THE PEOPLES' HERITAGE

This research has illuminated many hitherto only suspected aspects of landscape perceptions but, above all, has shown that landscape resource assessment based on public preferences rather than professional judgments or statistical predictions is possible and indeed a fruitful method of obtaining public input into the landscape planning process.

First of all it is contended that the assessments of landscape quality are more valid than professional judgments and statistical predictions in that there is a direct link between the assessment technique, and results in figure 1, and the underlying concept of landscape quality as more concerned with the human mind rather than the physical characteristics of topography and surface mantle. The degree of consensus was surprisingly high and the analysis of the reasons given for evaluations has shown that the different evaluations genuinely correspond to different views of the essence of scenic attractiveness of the areas and not merely to represent random variations in response.

Secondly, and developing from the first point, the results of this type of resource appraisal are demonstrably more useful to local planning and land management agencies. They give a direct public input to the planning process and, most importantly, can yield detailed information on reasons for low perceived landscape quality to which these planners and managers can address their attention in order to promote landscape enhancement policies; this is an area where local planning departments in Britain have power, particularly in controlling development, tree preservation and road alignment. This information can be used to set priorities within landscape conservation plans, so as to tailor expenditure to social goals within an integrated land management program, rather than allowing such participation only at design and implementatio stages. This approach could help to minimize conflict between planners and the public which has been all too familiar in Britain over the last ten years.

Finally, landscape is an important heritage resource in a crowded island such as Britain, yet it is undergoing rapid change fro agricultural "improvements," highway building programs and urban expansion (Westmacott and Worthington 1974, Coleman 1977). To secure greater sympathy between those with duties to conserve and enhance this heritage requires th public voice to be heard above the the highway lobby and the farmers' Landscape assessment methods which explicitly aim to capture this public view - recognizing landscape as a subjective phenomenon and not t be quantified in an objective and supposedly neutral scientific manner - will be more likel to secure the sympathetic conservation of this peoples' heritage than reliance on professiona judgment alone.

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Dimensions of Landscape Preferences from Pairwise Comparisons[1]

F. Gonzâlez Bernaldez and F. Parra[2]

Abstract: Analysis of landscape preferences allows the detection of major dimensions as:(1) the opposition between "natural and humanized", (comprising features like vegetation cover, cultivation, pattern of landscape elements, artifacts, excavations, etc.); (2) a polarity "precision/ambiguity" (involving opposition between: predominance of straight, vertical lines; contrast; recurrent patterns, etc./curved, diffuse forms, etc.) (3) a polarity "harsh, hostile, awe-inspiring/bland, welcoming" and (4) opposition between warm and cold colors. These trends are not completely independent and a more general trend opposing "unpredictable, uncontrolled" to "predictable, controlled environment" may be disclosed.

1. OBJECTIVE

This paper is a summary of the research studies carried out by our working group from 1973 at the University of Seville and continued at the Autonomous University of Madrid (Gonzalez Bernaldez et al. 1973; Garcia Novo et al. 1974, Sancho Royo 1974, Rődenas et al. 1975).

Although subjectivity is an important factor, often evoked in assessing aesthetic values of the environment, more experimental work has been devoted to finding common factors of agreement than to explore variance or structure in preferences within given populations. Our work is aimed at finding out typologies or dimensions of preferences, i.e., analyzing landscape selection to discover definite trends or ways of choos

The simplification obtained by means of factor analysis may be useful in facilitating further psychological and sociological experiments. For example, in further experiments combined with socioeconomical and psychological research the 15 most characteristic pi ture pairs instead of the 140 original have been used as stimuli (Maciá 1979

2. PROCEDURES

2.1 Picture Pairs Collections

The methodology used in the first series of studies has been described i detail by Sancho Royo (1974). Subjects were asked to choose a picture of ever pair from a collection of paired photographs or drawings. Picture-pairs collections portrayed different subjects:

2.1.1. A general landscape collection of 120 pictures from tourist books and drawings (Gonzalez Bernaldez et al. 1973, Sancho Royo 1974).

2.1.2. A collection of 80 picture portraying examples of large dams view in their landscape setting .(Rődenas et al. 1975).

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25,1979.

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2.1.3. A collection of 108 pictures portraying examples of the northern Madrid landscape (unpublished).

The picture pairs were mounted side by side on cardboard and bound into a booklet (2.1.1 and 2.1.2) or reproduced in slides (2.1.3).

After some trials the following procedure of pair arrangement was adopted:

(1) A broad subject for every experiment was selected (general landscape, large dams, northern Madrid landscapes).

(2) Picture subgroups within every subject were established ensuring within each subgroup similarity in subject distance, camera position and image cropping.

(3) Picture pairs within every subgroup were formed at random.

2.2. Data Processing

The results were coded as 1(left picture chosen) and 0 (right picture chosen) and punched on cards. 2 "coincidence" matrices (Sancho Royo 1974, Gonzalez Bernaldez _et al_. 1973) were computed: the landscape matrix and the subject matrix.

(1) In the landscape coincidence matrix, the elements a_{ij}, $i \neq j$, are the number of subjects that agree in selecting the picture at the same side of the image pairs i and j simultaneously. The elements a_{ii}, $i=j$ (main diagonal) are the total number of subjects.

(2) In the subject coincidence matrix, the elements a_{ii}, $i=j$, are the total number of image pairs.

(3) From both matrices correlation matrices were computed. In these matrices the elements r_{ij} are the correlations between row i and row j of the former matrices (1) or (2). Correlation matrices were subjected to principal component analysis. A varimax rotation was applied to the first axes representing 70 percent of original variance.

Other varieties of factor analysis suited for binary data, like contingency matrix (Ivimey-Cook and Proctor 1967) or correspondance analysis (Benzecri 1969), require the duplication of the rows corresponding to picture pairs and need increased computation power.

3. INTERPRETATION OF RESULTS

3.1. Inspection of picture pairs with the largest factors.

For every component, pairs having the largest factor (in absolute value) were sought. During inspection of the pairs of pictures having negative factors, the position of images was inverted. Pairs with the largest factors were inspected for common characteristics present in one side of the series.

3.2. Finding coordinates for subjects in the picture space.

For every component, the coordinates are computed as $\Sigma f_i \delta$, where f_i is the pictures factor for a given component and δ is equal to +1 (left picture chosen) or -1 (right picture chosen). Similar coordinates may be used to identify pictures with a high discrimination effect when subject coincidence matrix 2.2(2) has been computed.

3.3. Correlation with adjective lists.

Sets of characteristics like: "contrasted, welcoming, abrupt, cultivated", etc. may be inspected for correlation with components of factor analysis. The value +1 was attributed to those pairs of pictures in which than left side picture exhibited the considered characteristic in greater degree then the right side picture of the pair; the value -1 if the reverse was true, and 0 if the characteristic was exhibited with equal intensity by both sides or was not applicable at all. This evaluation was carried out by a panel of three members. When a discrepancy occurred, the value 0 (both sides having equal potency) was adopted. In this way , a score for a given characteristic may be computed for every subject as $\Sigma a_i . \delta$, where a_i is the value of the picture pair determined as described, and δ is equal to +1 (left picture chosen) or -1 (right picture chosen). Thus correlations may be computed between scores and factors (figures 1 to 4).

Table 1--Preference differences for subjects belonging to contrasting sociological categories (After Gonzalez Bernaldez et al. 1973, Ródenas et al. 1975 and Sancho Royo 1974)

Preference Polarity:

	humanized landscape	natural landscape
Sex	women (students)	men (students)
Occupation	farmers	university students
Occupation	housewives	university students

4. SUBJECT POPULATIONS

Subjects were in most experiments university students but subjects belonging to different populations were used. Housewives, farmers and university students were considered representatives of large sociological categories but the groups were rather intended as "markers" or "tracers" to study distribution in the component space.

These experiments resulted in clear cut differences ($p< 0.01$) regarding one of the factors, the "humanized landscape" "natural landscape" for socio-professional differences (Gonzalez Bernaldez et al. 1973, Ródenas *et al*. 1975; Sancho Royo 1974). A summary is presented in table 1.

5. LANDSCAPE PREFERENCE DIMENSIONS

Repeated experiments with different populations and materials, and comparison of rotated and non-rotated solutions give information on the stability of some directions of variation that tend to recur under different circumstances. Reification contents have been grouped under more ample labels N, A, H, and C by the simultaneous application of the following criteria:

(1) Independency between groups and dependency within a group regarding their frequency of correlation in the different analyses.

(2) Similarity of the semantic content of the reification of the components obtained in the different analyses. Components have been classified under bipolar groups N, A, H and C, according to similarity:

Group N : Nature/Culture	Experiment number (table 2)	Component (r=rotation)
-natural landscape/artificial landscape (involving low plant cover, cultivation, patterned distribution, artifacts)	(1)	I
-high vegetation cover/low vegetation cover	(1)	I_r
-natural landscape/artificial landscape (low tree cover, regular distribution, cultivation flat reliefs, buildings)	(2)	I
-high vegetation cover/low vegetation cover	(2)	II_r
-high vegetation cover, less stripping and excavation/low plant cover, stripping, excavation	(4)	V_r
-natural landscape/artificial landscape (low plant cover, etc.	(3)	I
-natural landscape/artificial landscape (excavations, machinery, buildings, muddy water, low plant cover)	(4)	I
-random distribution, diversity, lack of houses/patterned distribution, low diversity, presence of houses and roads	(2)	I_r
-conspicuous artifacts enhanced by vertical pattern and contrast/dissembled artifacts	(4)	I_r

	Experiment (table 2)	Component (r=rotation)
Group A : Precision/Ambiguity		
-rounded, broad trees/slender trees	(1)	III$_r$
-slender, sharp, straight forms/rounded, diffuse, sinuous forms	(1)	III
-sharp, straight, slender forms/rounded, diffuse, divagating forms	(2)	III
-sharp, straigth, slender forms/rounded, diffuse	(2)	III$_r$
-sharp, precise contours/blurred, diffuse contours	(3)	III
-rounded forms, horizontality /slender forms, verticality	(3)	IV
-contrasted/monotone	(3)	II$_r$
-verticality, contrast, pattern/horizontality, monotony, random distribution	(4)	II
-clean shades/gray tonalities (in color pictures)	(4)	IV$_r$
-straight, vertical lines; contrast; cold colors, pattern/curvature, horizontality, warm colors	(4)	III
-straight lines/curved lines	(4)	III$_r$
Group H : Harsh, Hostile, Awe Inspiring/Bland, Welcoming		
-harsh, contrasted/welcoming, monotonous	(1)	II
-rough, barren/fertile, friendly	(1)	V$_r$
-rough, harsh, hostile/welcoming, friendly, bland	(2)	II
-contrasted,cold, abrupt, rocky, arid/monotonous, warm, flat, fertile	(3)	II
Group C : Warm Colors/Cold Colors		
-warm colors/cold colors	(4)	II$_r$

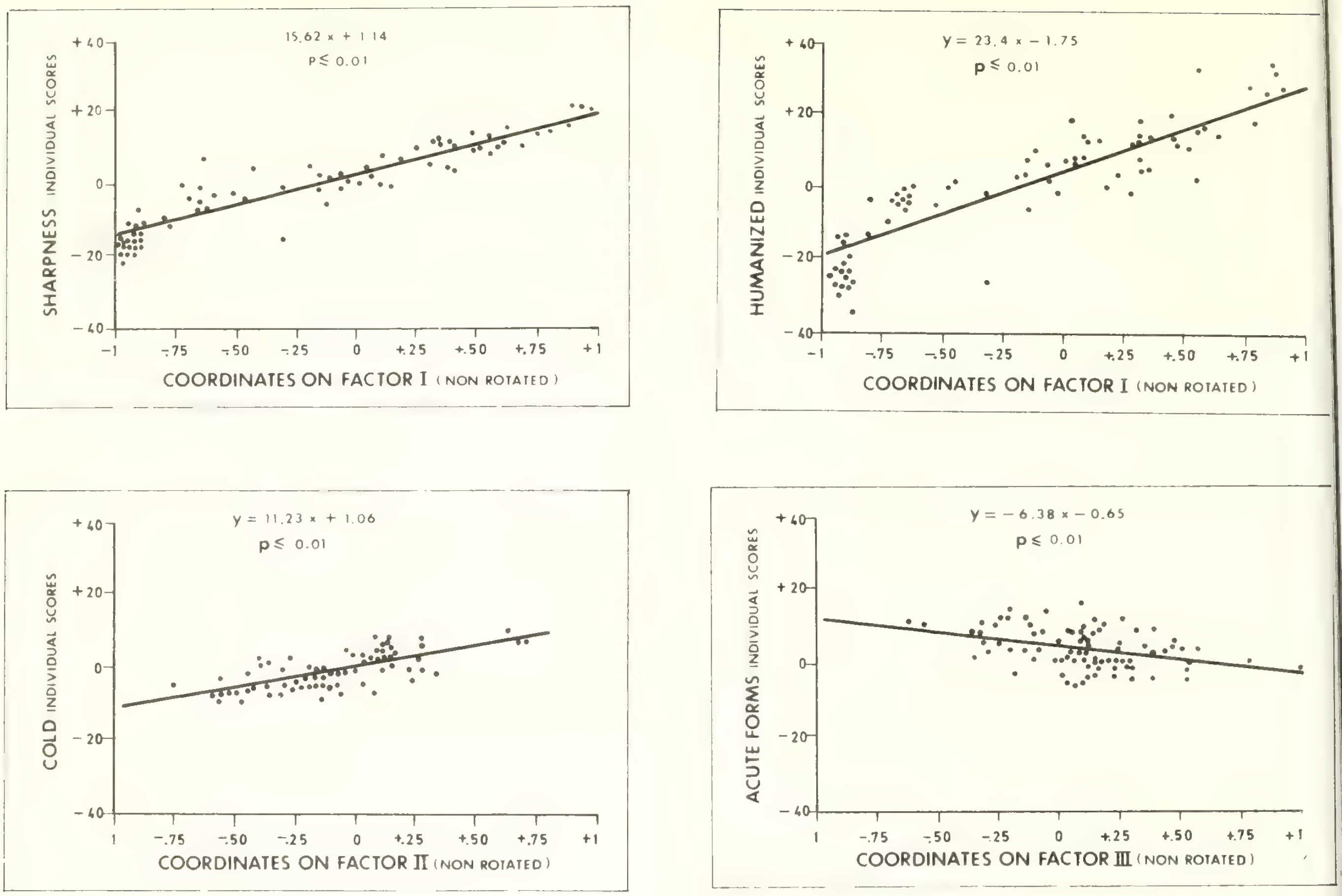
Bipolar group H (harsh, hostile, awe inspiring / bland, welcoming) fails to materialize with pictures of large dams. This may be explained by the rather restricted environment portrayed in this series.

Different contents or reifications within the groups N, A, H and C may appear loose or united within each group, forming more or less complex entities. Rotations usually resulted in a decomposition of the content giving rise to simpler contents. For instance, the important component (in variance absorption terms) "natural landscape/humanized" involves differences in : vegetation cover, randomness of distribution of landscape elements, absence or presence of cultivation, buildings, machinery, traces of human activities, more or less abrupt relief, etc. When Varimax rotation is applied the content tends to become simpler, giving rise to new factors with reifications like : degree of vegetation cover (exclusively), regular pattern in element distribution (exclusively) etc. (Sancho Royo 1974).

More rarely, rotation provokes fusion of simple contents in a more complex factor. This happens in the case of the first principal component of population (4) "natural landscape/artificial landscape" and the second component, "verticality, contrast/horizontality, monotony". Both contents are compounded in a new factor, "natural, horizontal, monotonous/artificial, vertical, contrasted" (first component) after rotation (Ródenas et al. 1975, page 170).

6. SIGNIFICANCE OF THE LANDSCAPE PREFERENCE DIMENSIONS

As expected, the dimensions obtained are rather general and abstract. They seem to apply equally well to photographs as to actual landscapes although some of them tend to represent more "content" than "formal" aspects. For instance groups N (nature/culture) and H (harshness/welcoming) coincide in representing a "content" that requires "perception" or interpretation of a scene to which a signification is attributed. On the contrary, groups A (ambiguity/precision) and C (colors) represent "formal" aspects that do no require interpretation and thus do not need true "perception" of the exhibited scene.



Figures 1 to 4--Examples of relationships between adjectives and principal components of landscape preference analysis. Experiment (3). Regressions are computed between subject factors and subject scores for adjective lists (3.3) (Data from Garcia Novo et al. 1974, and Sancho Royo 1974).

Table 2--Population of Subjects of the Experiments. GLC - General Landscape Collection 2.1.1. LD - Large Dams 2.1.2. NML - Northern Madrid Landscapes 2.1.3

Picture Material	Number of Pictures	Subject Population	N	Locality	Experiment Code for Reference
GLC	120	University students	60	Seville	(1)
GLC	120	University students, sex ratio 1:1	75	Seville	(2)
GLC	120	University students + farmers	80	Seville	(3)
LD	80	University students + housewives	84	Seville	(4)
NML	108	University students	279	Madrid	(5)

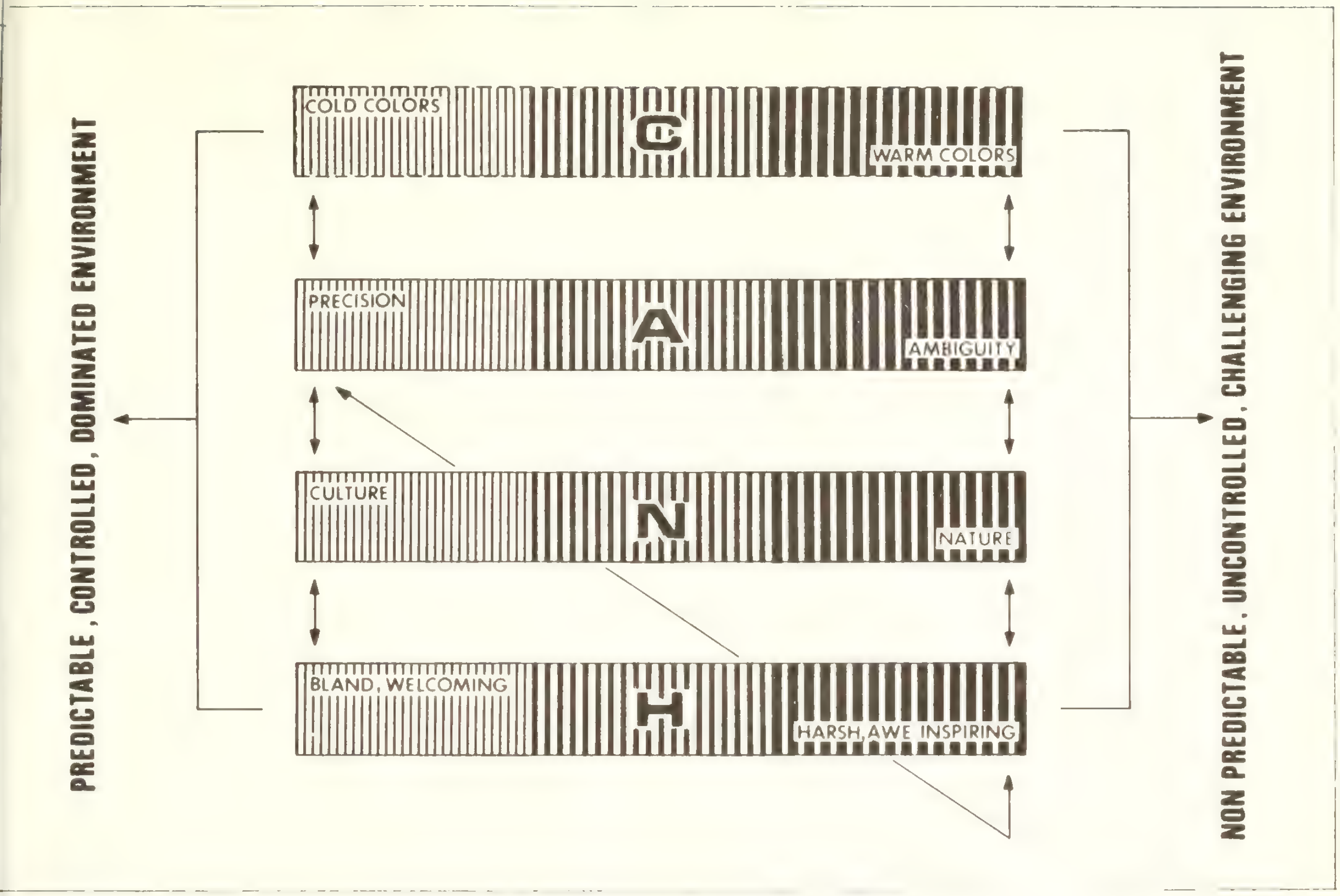

PREDICTABLE, CONTROLLED, DOMINATED ENVIRONMENT
COLD COLORS
C
WARM COLORS
PRECISION
A
AMBIGUITY
CULTURE
N
NATURE
BLAND, WELCOMING
H
HARSH, AWE INSPIRING
NON PREDICTABLE, UNCONTROLLED, CHALLENGING ENVIRONMENT

Figure 5--Reticulate relations (by occasional correlation) between bipolar groups N, H, A and C. Arrows represent between-groups correlation.Groups have been obtained by classification of trends of variation that tend to recur in the different experiments.

In figure 5 the structure of relations between the large groups is shown. Groups N (nature/culture) and H (harshness/welcoming) are somewhat related by the nature and harshness poles. It has been observed that the pole "precision" enhances the humanized or cultural character of the environment (Ródenas et al. 1975). Nevertheless, acute, sharp forms may be related to the "harshness" pole in some experiments (Sancho Royo 1974). This conflict results in the lack of linear relations between groups N, H, A in figure 5 where an inversion or crossing-over between "precision" and "harshness" is represented by the oblique arrow.

Occasional connections between two concepts classified in different groups may be interesting. As mentioned "verticality" (group A) may fuse with "artificial" (group N), "contrast" (group A) with "harshness" (group H), "curved forms" (group A) with "warm colors" (group C) and "natural" (group N) with "harshness" (group H).Arrows represent this occasional fusion between group correlations in figure 5.

It is interesting that concepts found while interpreting the main trends of choice seem to coincide with some intuitive ideas used in history of the fine arts . The tension between natural and humanized landscape has been amply commented as a polarity dominating opposite attitudes in gardening and landscaping (Lopez Lillo and Ramos 1969). The association between the pole "culture" and "precision" (fig. 5) can be expressed as humanization of the environment enhanced by the presence of straight lines, regular patterns, contrast as opposed to curves, sinuosities, lack of pattern and diffuse contours which corresponds to the classical/baroque opposition considered in style studies (Wolfflin 1950, Seldmayr 1959). This opposition represents the tension between predictability (precision) and the lack of predictability (ambiguity) evoked by Bollnow (1963) as a characteristic of the opposition between renaissance and baroque.

Association of naturalism and lack of predictability versus humanization (culture) and predictability evokes the relation between painting or architectural styles and the "external control/internal control polarity" studied by Juhasz et al. (Juhasz and Paxson 1978a, Juhasz and Paxson 1978b). The external locus of control (fatalism) would be related to the naturalistic unpredictability trend. Relations with the nature/culture dialectics of some french structuralists are also evident.

Concepts of hostility, awe-inspiring, harshness, etc. (group H) have been noted many years ago as an important ingredient of man-environment relationship. Bollnow (1963) considers the tension between menacing space and welcoming space (or refuge) as the focal center of his theory of man-space relations. The role of alert and attention-arousing stimuli in relation to aesthetical preferences has been mentioned by Berlyne (1960). The association of the "harshness, risk-taking" pole of N is also coherent, having a romantic meaning (Bates 1960).

Most of the relations may be consistently structured in the way shown in figure 5. A very general polarity may be remarked in the form of a tension between:

(1) Non-predictable, uncontrolled (fatalistic?, random?) risk evoking, challenging environment.

(2) Predictable, controlled, dominated environment.

These extremes may represent a permanent tension in man-environment relations. It may be observed that passage from (1) to (2) types of environment sums up the development of human civilization. Preferences for type (1) of environment persist today as types of sensibility in aesthetics, sports, outdoor activities and environmental attitudes.

7. REMARKS

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Numerical Modeling of Eastern Connecticut's Visual Resources[1]

Daniel L. Civco[2]

Abstract: A numerical model capable of accurately predicting the preference for landscape photographs of selected points in eastern Connecticut is presented. A function of the social attitudes expressed toward thirty-two salient visual landscape features serves as the independent variable in predicting preferences. A technique for objectively assigning adjectives to landscape scenes is also discussed. This Landscape Preference Model has received field application in parts of eastern Connecticut for evaluating the effects of human activities on scenic quality.

INTRODUCTION

Among other objectives, the National Environmental Policy Act (NEPA 1970) of 1969 provides guidelines for the assurance of ". . . safe, healthful, productive, and aesthetically and culturally pleasing surroundings . . ." for all Americans. Landscape assessment, which reflects the social and psychological perceptions of natural and man-made environments, is an essential tool for measuring the direction and magnitude of the impact of human activities upon the visual resource. Landscape assessment can be described as a procedure for identifying preferred landscapes and their visual components (Kaplan 1975). Landscape assessment utilizes the evaluation of visual qualities or characteristics within a series of landscapes to determine the relative relationships between those landscapes (Laurie 1975).

A number of the many landscape assessment and scenic assessment models developed have been collectively reviewed (Arthur and Boster, 1976; Bagley *et al.* 1973). Many of these techniques provide planners with information on the preference for visual landscape resources.

The sophisticated methods developed by landscape specialists should be applied with caution. Involvement with numerical indices, social attitude values, or other quantitative measures should not become so extreme that the user becomes alienated from the sensitivity necessary to appreciate visual landscape phenomena.

LANDSCAPE ASSESSMENT: A BRIEF REVIEW

In the past decade, there has been a variety of approaches developed to assess the visual environment. One of the earliest techniques was a methodology for classifying roadside scenery (Burke *et al.* 1968). A similar technique (Sargent 1966) provided a model with which the landscape analyst uses a cardinal scale, of 1 to 10, to rate the scenery of interest. There are a number of other comparable subjective, and sometimes graphic, approaches to the art of visual landscape assessment (Laurie 1975, Litton 1968, Litton 1971, Palmer 1973, Tandy 1967) each having its own level of validity and appropriateness.

Recognizing that objective measures of visual quality are necessary to certain environmental decision-making processes, a number of researchers have developed landscape assessment methods in which the rating reflects statistically derived preference responses. Rigorous mathematical approaches such as factor analysis and multiple regression have been applied to sets of rank ordered landscape photographs in order to produce these predictive models (Shafer *et al.*, 1969, Shafer and Mietz, 1970, Pitt 1976). Some investigators have tested the real-world applicability of their models by conducting on-site studies of landscape scene preference (Zube *et al.* 1974).

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Another approach in objectively quantifying visual resources has been the use of the Delphi Method, which uses an iterative-feedback questionnaire. Such a survey was conducted of professionals in landscape architecture, environmental design, and related disciplines to generate value functions to be used in a comprehensive environmental impact assessment strategy for water resources planning (Dee *et al.* 1972, Dee *et al.* 1973). Aesthetics, consisting of seventeen parameters, was one of four major components of the impact evaluation system. The visual assessment aspect of this model has been transformed from its original graphic representation into a computer program version (Civco 1975).

A conclusion repeatedly reached in many of these landscape assessment and scenic quality evaluation studies is that each model is highly region-dependent. Visual landscape composition varies from one locale to another as do the attitudes toward and preferences for these landscapes. Therefore, landscape assessment models should be applied in the specific geographic area in which they were developed, or in regions with highly similar physiographic, cultural, and socio-economic characteristics. The objective of this particular study was to construct a numerical model of preference for salient visual landscape resources, specifically of selected parts of eastern Connecticut.

THE STUDY

Most of the landscape scenes used in this study were in or near the town of Mansfield, Connecticut, located in the northeastern hills region of the state. Mansfield typifies much of eastern Connecticut in terms of physiography and visual landscape composition. The landscapes investigated were representative of those types frequently encountered in eastern Connecticut. Further, the compositions of these landscapes depicted, in varying degrees, thirty-two of the landscape features identified by other researchers (Zube *et al.* 1974) as being significant visual resource components. These included:

lakes and streams
broadleaf trees
mixed trees
evergreen trees
rocks and ledges
hills
mountains
valleys
plains
slopes
ridges
shorelines
pastures
skyline
wetlands
natural clearings
ground cover
man-made clearings
edge of clearings
shrubs
walls
tilled fields
roads
farm buildings
houses and buildings
shopping areas
factories
fences
power lines
signs
gas stations
suburban development

Fifty 35mm high speed Ektachrome color photographs were taken of different landscape continua. Using the criteria of landscape-representativeness and photographic quality, this initial sample of fifty landscape continua was reduced by a class of landscape architecture students at The University of Connecticut. The thirty landscape photographs most frequently chosen were used for inclusion in the study. This final sample was then randomly sorted into two groups: one of twenty photographs, for the experimental procedures in the formulation of the landscape assessment model, and one of ten photographs for the test of the model. While the two sets of photographs were taken from the same general region, each scene depicted a distinct landscape.

Phase I: Survey Technique and Data Gathering

The initial phase of the study involved the determination of scenic quality as portrayed in the first set of color landscape photographs (n=20). Interviews were conducted with 200 study participants on an individual basis. These interviews took the form of a detailed questionnaire consisting of three sections: collection of pertinent demographic data, landscape feature evaluation, and landscape scene rank ordering.

Using a modified Q-sort method (Stephenson 1953), which assured uniform sampling stratification, subsets of the twenty photographs were formed. Each participant was given a set of four landscape photographs and was instructed to rate each of the thirty-two landscape features in terms of its contribution to or detraction from the overall scenic quality of the landscape. The scale graduated from 1 (strongly detracts) to 7 (strongly contributes), with a value of 4 indicating neutrality. If a landscape feature was not present in a scene, the participant recorded a value of 0 (absent) for that respective landscape feature.

Again, with sets of photographs having been selected using a modified Q-sort method, each participant was given a set of ten landscape photographs and was requested to rank them in descending order of scenic quality (*i.e.*, 9=most scenic, 0=least scenic). As a result of staggering (modified Q-sort) the observations, each of the twenty landscape photographs was "feature evaluated" forty times and rank ordered one hundred times after all 200 participants had been interviewed.

Phase II:
Scenic Quality Adjective Assignment

Realizing that numerical indices are not always the best way in which to describe the scenic quality of a landscape continuum (*e.g.*, some people prefer to communicate in common language rather than mathematical expressions), correlations were made between visual appeal adjectives and the rankings of the landscape photographs. To provide the data to make this comparison, another sample of fifty participants was selected and each was instructed to sort the twenty original landscape photographs into seven "scenic quality" piles. The possible categories included: extremely scenic, scenic, slightly scenic, neutral, slightly non-scenic, non-scenic, and extremely non-scenic.

Phase III:
Test of the Landscape Preference Model

In order to provide data to test the strength of the preference prediction model, the second set of landscape photographs (n=10) was rank ordered by another sample of fifty observers. In this instance, each participant examined the entire set.

DATA ANALYSIS

In the first phase of this investigation, the rank ordering procedure produced a set of arithmetic mean values ($\bar{Y}_j$), which were derived from the data of the rank orders of the twenty photographs. Therefore, each photograph was assigned its mean rank value (or relative preference) and whole number rank order (Y_j).

A test of the consistency of the rank order procedure and the associated mean rank value ($\bar{Y}_j$) was performed using the Chi-square statistic (Ostle 1963). The concept of consistency involves uniformity in the participants' assignment of rank orders to the photographs. It was expected that the mean rank value of the least preferred landscape and that of the most preferred landscape would be in the ratio of 20:1. Expected mean rank values ($e\bar{Y}_j$) were calculated for all twenty rank order positions based upon this distribution theory.

The determination of landscape feature valuations involved statistical averaging of the mean landscape feature value for each feature (n=32) in each individual photograph (n=20), as well as for each feature considering the set of photographs as a whole. These resultant values were considered to be representative social attitude values demonstrated toward a particular feature (x_i) and a representative example of that feature (X_i).

Model Formulation

The approach used to generate a mathematical model capable of predicting preference for visual landscape resources involved feature reduction and description of the entire landscape continuum (as represented by the photograph) by a single index. This single value is different for each photograph and is equal to the sum of each particular photograph's representative landscape feature valuations (X_i) divided by the number of landscape features present in the continuum. Therefore, the new variable $\bar{X}_i$, is an unweighted index illustrative of a landscape photograph's composition as a whole.

After having expressed the landscape feature composition of a landscape continuum as a single value ($\bar{X}_i$), it was necessary to find the relationship between this independent variable and the dependent variable, mean rank value or $\bar{Y}_j$. The statistical procedure used was polynomial regression analysis. The general form of the type of polynomial used was:

$$\bar{Y}_j = a + b_1\bar{X}_i + b_2\bar{X}_i^2 + b_3\bar{X}_i^3 + \ldots b_k\bar{X}_i,$$

where $\bar{Y}_j$ represented mean rank value, *a* represented the X-axis intercept, $\bar{X}_i$ represented mean photographic content, *b* the coefficients, and *k* was the degree of the exponent of the independent variable. In order to be accepted, the prediction equation had to result in a coefficient of at least 0.85 in terms of both mean rank (Pearson's) and absolute rank order correlation (Spearman's).

Phase II of this study involved the assignment of adjectives describing the visual quality of landscape continua to their respective photographs. Adjectives were given values of from 1 (extremely scenic) to 7 (extremely non-scenic).

The adjective ratings for each of the twenty experimental photographs were averaged, and these values were identified as a new dependent variable, mean adjective score. Regression analysis was applied to the photographs' predicted mean rank values ($\bar{Y}_j$) and the adjective scores.

Test of the Model

The observed mean rank values, and the absolute rank orders, of the set of ten test photographs were calculated from the data gathered during Phase III. The prediction preference model was applied to these ten landscape photographs as described by their feature composition (mean feature valuation or $\bar{X}_i$). Both predicted mean rank order and absolute rank orders were calculated. These predicted values were compared with the observed values by using Pearson's correlation coefficient and Spearman's rank order correlation coefficient.

The predictive model had to produce correlations of at least 0.85 at the one-percent significance level in order to be accepted and adopted for use in modeling eastern Connecticut visual landscape resources.

RESULTS AND DISCUSSION

Landscape Photograph Rank Order

A high degree of uniformity was observed in the way in which the twenty original landscape photographs were rank ordered (Table 1) by the initial 200 study participants. The most preferred landscape, Photograph Number 2, consisted mainly of a rocky stream lined with coniferous trees, and was consistently, highly ranked (σ=0.76). The most consistently (σ=0.27) least preferred landscape, Photograph Number 19, depicted a typical 1960's shopping center. Scene Number 17 was noticeably ranked inconsistently, and was primarily composed of two visually contrasting landscape features--a factory and a stream.

Table 1--Rank Order Parameters for Twenty Experimental Photographs

Photograph Number	Expected Mean Rank Order, $e\bar{Y}_j$	Observed Mean Rank Order, $\bar{Y}_j$	Standard Deviation (σ)	Absolute Rank Order
1	4.68	3.59	0.86	11
2	0.45	1.23	0.76	1
3	0.90	1.77	1.21	2
4	2.97	3.25	0.98	7
5	1.26	2.07	0.82	3
6	3.42	3.33	1.63	8
7	5.58	4.97	1.01	13
8	3.87	3.35	0.69	9
9	5.13	4.88	1.72	12
10	2.61	3.08	1.64	6
11	1.80	2.09	2.12	4
12	6.03	4.99	0.56	14
13	8.10	7.97	1.56	19
14	4.23	3.43	1.29	10
15	7.74	7.94	1.16	18
16	6.39	5.38	1.52	15
17	2.16	2.86	2.22	5
18	6.84	7.13	0.89	16
19	8.57	8.77	0.27	20
20	7.29	7.92	0.63	17

Landscape Feature Evaluation

The direction and magnitude of visual impact imparted by salient visual resources were determined by the valuation of the thirty-two landscape features. These results are presented in Table 2. The data can be considered as social attitude indices of the representative contribution of each visual landscape feature toward scenic quality (conditioned, of course, by the range of landscapes and the participants used in this study). Features with a value of greater than four have a positive visual impact, while those less than four have a negative visual impact. A value of four indicates visual neutrality. It is evident that water, trees, landforms and other apparently natural features have a significantly positive impact on the visual environment, while many man-made features, such as shopping areas, gas stations, and signs, have a definite negative impact.

Mathematical Model

A fourth-order polynomial regression equation, with mean landscape feature content (X_i or $\Sigma X_i/n$) as the independent variable was found to be able to predict accurately the preference for the twenty experimental landscape photographs. Mean landscape feature content ($\bar{X}_i$) is determined, as described previously, by averaging the social attitude indices (X_i), given in Table 2, for all the features present in a landscape scene.

Table 2--Landscape Feature Valuations

Landscape Feature	Mean Social Attitude Value, X	Standard Deviation (σ)	Number Times Observed
Lakes and Streams	6.2	.562	240
Broadleaf Trees	5.8	.748	760
Mixed Trees	5.8	.618	480
Rocks and Ledges	5.8	.931	240
Hills	5.8	.681	440
Mountains	5.6	.283	80
Natural Clearings	5.4	.277	120
Farm Buildings	5.4	.954	40
Valleys	5.2	.890	440
Evergreen Trees	5.2	.812	520
Wetlands	5.2	.481	80
Plains	5.2	.071	80
Pastures	5.2	.392	160
Slopes	5.0	.676	440
Ground Cover	5.0	.530	680
Skyline	5.0	.659	760
Shorelines	4.8	.786	240
Ridges	4.8	.925	400
Edge of Clearings	4.8	1.005	600
Walls	4.6	1.010	40
Shrubs	4.6	.747	360
Tilled Fields	4.4	.467	120
Roads	3.8	1.019	360
Man-made Clearings	3.4	1.149	640
Houses and Buildings	3.2	.691	200
Shopping Areas	3.0	1.145	80
Factories	3.0	.909	160
Fences	2.8	1.358	160
Power Lines	2.4	.876	320
Signs	2.2	1.333	240
Gas Stations	2.2	.521	40
Suburban Development	1.8	.936	120

The actual form of the Landscape Preference Model is:

$$\bar{Y}_j = 920.754807 - 840.5848039\ \bar{X}_i + 288.2842356\ \bar{X}_i^2 - 43.5473328\ \bar{X}_i^3 + 2.4349968\ \bar{X}_i^4,$$

where $\bar{Y}_j$ represents predicted mean rank order and $\bar{X}_i$ represents mean landscape feature content of a particular landscape photograph. When applied to the sample of twenty photographs, the model produced a correlation between observed and predicted mean rank order of better than 0.90.

Adjective Assignment

Linear regression analysis, applied to the mean rank order of each of the twenty experimental photographs and its corresponding adjective numeric, produced a correlation of 0.98. This significant relationship indicated that this sample of observers could consistently describe the landscape photographs with similar adjectives. Further, since mean rank order and the adjective numerics are directly associated, descriptors of scenic quality can be assigned to a series of landscape photographs.

Test of the Model

The resultant Landscape Preference Model, represented by the fourth-order polynomial, was applied to the second set of landscape photographs (n=10) from selected points in eastern Connecticut. The observed mean rank values and absolute rank orders were determined during Phase III of the experiment and served as the basis for evaluating the preference prediction equation. The observed and predicted parameters are shown in Table 3. Additionally, the predicted adjectives of scenic quality are present It can be seen from these results that the model produced accurate predictions; Pearson's correlation of mean rank value was 0.88, and Spearman's rank order correlation was 0.93, both significan at better than the one-percent level.

Figures 1*and 2*depict two landscape photographs used in the design of the preference prediction model. Figure 1* represents the second most highly preferred scene, both observed and predicted, and was described as "scenic" by the study participants. Figure 2* illustrates a "non-scenic" landscape photograph, being one of the least preferred scenes.

Examples of the scenes used to test the model are shown in Figures 3*and 4* The first of these scenes was the most highly preferred, as observed and as predicted by the model, and can be described as "scenic to extremely scenic" within the context of eastern Connecticut's visual resources. The second scene (Figure 4*) was the least preferred and is representative of a "non-scenic" landscape.

APPLICATIONS OF THE MODEL IN EASTERN CONNECTICUT

The Landscape Preference Model has received field application in parts of eastern Connecticu

Table 3--Observed and Predicted Rank Order Parameters for Ten Test Photographs

Photograph Number	Mean Feature Content, $\bar{X}_1$	Observed Mean (Absolute) Rank Order	Predicted Mean (Absolute) Rank Order	Scenic Quality Score	Scenic Quality Adjective
1	5.05	3.08 (3)	3.05 (3)	2.76	slightly scenic to scenic
2	5.69	1.18 (1)	1.08 (1)	1.62	scenic to extremely scenic
3	5.02	3.40 (4)	3.26 (4)	2.87	slightly scenic to scenic
4	5.27	1.84 (2)	1.83 (2)	2.05	scenic to slightly scenic
5	3.78	4.28 (6)	7.59 (9)	5.37	slightly non-scenic to non-scenic
6	3.71	8.02 (10)	7.73 (10)	5.45	non-scenic
7	4.46	6.88 (8)	6.27 (7)	4.61	slightly non-scenic to neutral
8	4.93	3.82 (5)	3.83 (5)	3.20	slightly scenic to scenic
9	4.80	4.90 (7)	4.62 (6)	3.66	neutral to slightly scenic
10	4.01	7.60 (9)	7.27 (8)	5.18	slightly non-scenic to non-scenic

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*See color illustration on page 390.

As a member of the eastern Connecticut Environmental Review Team, the author has used the model on several occasions to determine the scenic character of specific projects. These evaluations have been used to rate the visual effect and suitability of development activities ranging from an industrial park to housing subdivisions to outdoor recreation facilities.

Currently, the Landscape Preference Model is being modified to be made compatible with a computerized mapping program under development. This spatial data analysis program is being applied to a section of eastern Connecticut scheduled for a planned highway relocation and extension. One of the policy determinants for computer-assisted highway corridor siting is the "minimization of impact to visual landscape resources." A version of the Landscape Preference Model will supply the baseline information necessary for such a determination.

SUMMARY

The numerical analysis of visual landscape resources, as depicted by color photographs from selected points in Eastern Connecticut, demonstrated that there are noticeable tendencies in observers' preferences and dislikes for these scenes. Statistical studies showed that landscape features were perceived similarly by different individuals and that the visual importance of these elements could be expressed in terms of a social attitude index. A mathematical function performed upon a reduction of the values of the landscape features composing a given landscape photograph continuum was found to be able to predict the preference both numerically and descriptively. A ranking of a number of these landscape photographs has shown the relative preference for each and permitted the overall evaluation of the landscape photograph sample.

It should be noted that this model is directly applicable only in situations where the conditions approximate those set forth in this study. If a similar approach were to be tried elsewhere, the landscape-type compositions and population socio-economic factors should be considered and the results qualified accordingly.

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The Derivation of Scenic Utility Functions and Surfaces and Their Role in Landscape Management[1]

John W. Hamilton, Gregory J. Buhyoff and J. Douglas Wellman[2]

Abstract: This paper outlines a methodological approach for determining relevant physical landscape features which people use in formulating judgments about scenic utility. This information, coupled with either empirically derived or rationally stipulated regression techniques, may be used to produce scenic utility functions and surfaces. These functions can provide a means for setting landscape management objectives and evaluating the efficiencies of alternative management strategies.

INTRODUCTION

The problem areas of landscape preference prediction and aesthetic impact assessment have emerged as important research topics. This research has been legislatively mandated, and that mandate is reinforced by our desire to properly allocate and manage scenic resources. Vision plays an extremely important role in processing information and has even been demonstrated to dominate other sense modalities (Rock and Harris 1967). Despite the fact that a significant proportion of the information that man processes is visual, we have limited knowledge about how visual bits of information are modified and interpreted to stimulate sensations of pleasure and displeasure.

However, over the past ten years, concentrated research efforts have produced several workable prediction models, a variety of methodological frameworks and some surprisingly consistent results. Much of the foregoing research has been somewhat molecular in nature -- that is, it has concentrated on predicting preferences for limited subject populations, methodological testing and development, validity testing of simulations, prediction of preference of singular landscape modifications and checking for biases in landscape research which could affect the internal validity of our models and techniques. Nevertheless, it is our feeling that these research efforts were properly limited in scope. Without such simplified testing and methodological probing, we would be attempting to build an atomic reactor without first understanding the nature of sub-atomic particles.

It appears that the point has been reached where the development of more elaborate and theoretically rational models can proceed.[3] Specifically, these detailed models should be able to make predictions of overall preference for scenic beauty magnitudes and estimate changes in these values resulting from physical landscape changes. The requirement of interval scaling is necessary, we believe, since this allows the planner to answer the question of "how much better?" or its corollary of "how much worse?." Rank or ordinal values of preference do not, technically, permit such answers. Obviously, the model should also permit the assessment of changes in quantities of preference resulting from changes or differences in a mix of landscape dimensions or elements. This would then allow us to begin thinking within the framework of objective aesthetic impact assessment.

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The authors would like personally to thank the reviewers for their assistance in making this complex subject more coherent.

[3] A rational model is one which is based in theory, and is distinct from empirical models which are derived strictly by means of fitting functions to data.

Shafer et al.'s (1969) work was an early attempt to develop a predictive model for landscape preference. Specifically, physical landscape measures taken from photographs were used to predict a rank-sum value of preference. Through examination of Shafer et al.'s model, many researchers obtained a glimpse of the effects of certain physical variables on visual preference. However, because the intent of model was prediction and not explanation, the mathematical complexity of some of the combinatory variables defied even conceptual cause-effect explanation. In addition, the dependent variable (visual preference) was still only an ordinal value.

Interest in the measurement of magnitudes of preference and scenic beauty led Daniel and Boster (1976) to develop a method based on Signal Detection Theory whereby Scenic Beauty Estimates (SBE's) could be computed for landscapes. This method has been successfully used to develop models of landscape assessment using mensurational parameters as predictors of preference (Arthur 1977), to gauge the visual effects of silvicultural treatments (Daniel et al. 1973, Schweitzer et al. 1976) and to develop a mapping procedure for scenic beauty in forested landscapes (Daniel et al. 1977). Other attempts at measuring interval preferences also rest on the foundations of psychophysical scaling methods similar to Signal Detection Theory. Jackson et al. (1978) utilized the Law of Comparative Judgment and the Luce Axiom to obtain estimates of visual impacts of power-line corridors.

Therefore, it seems that magnitude estimates of preference can be made for an overall scene. The problem, then, is to relate fluctuations in these magnitudes to specific physical changes in the visual environment. In this way it might be possible to specify mathematical models or functions which characterize the visual perceptual process and which eventually may lead to the development of scenic utility functions. The purpose of this paper is to discuss some possibilities for research in this area.

Psychological Disutility Functions -- A Start

In an effort to estimate the aesthetic impacts of southern pine beetle (SPB) damage, Buhyoff and Leuschner (1978) were able to estimate reliably magnitudes of preference for forest landscape scenes with a variety of types and levels of SPB damage. Preference was measured using the Case III assumptions of the Law of Comparative Judgment. Details of this methodology can be found in Buhyoff and Riesenman (in press). This methodological procedure produced interval preference scores for landscapes which were then correlated with changes in SPB damage. Non-linear regression techniques were used to estimate the drop in scenic preference with increases in SPB damage. The resulting curves, shown in Figure 1 for both informed and naive subjects, were called

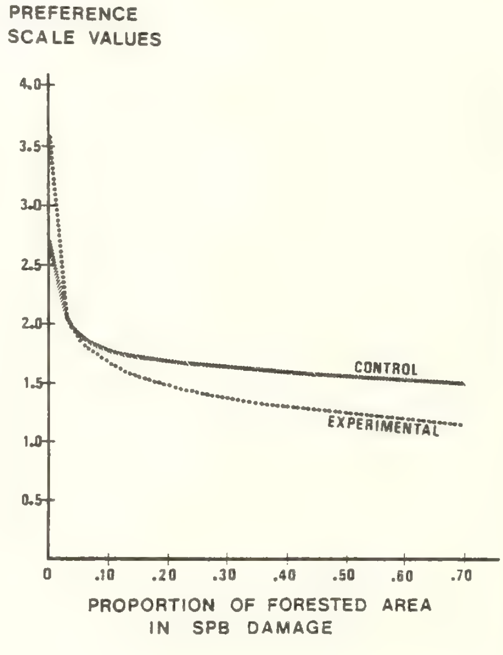

Figure 1. An example of a two-dimensional psychological disutility function. Reprinted with permission of Forest Science.

psychological disutility functions (Buhyoff and Leuschner 1978). The inflection points of these functions can be used to set practical management guidelines. For example, for the experimental group in Figure 1, the slope of the disutility function is very steep at low levels of insect damage, while declines in preference for SPB damage past approximately 10 percent of the visible forested area much less rapid. Experimental data collection techniques permitted "forced" subject cueing on a single dimension, thereby producing nonlinear models which accounted for approximately 0.86 of the variability in landscape preference scores. Lower amounts of variability in preference ($R^2 = 0.33$) were accounted for when people did not cue on a single dimension. These findings indicate that a multidimensional space must be defined, since the viewing process is undoubtedly more holistic than that which is artificially created by experimentally manipulating the overall landscape scene and/or the dimensions and characteristics which are viewed.

The construction of multidimensional scenic utility functions is a natural extension of such two-dimensional procedures. Two types of techniques will be discussed wherein the landscape perception process may be quantitatively represented as the interaction of (N) dimensions which produce a mathematical surface. One technique, multidimensional scaling, is appropriate when the underlying dimensions of a landscape are not known. Judgments of similarities between landscapes produce a perceptual map identifying dimensions important to the judge(s). A similar technique, Smallest Space Analysis, has been previously and successfully applied to landscape research (Kaplan et al. 1972, Kaplan 1975). A second technique, policy-capturing, is a simple extension of the SPB example in that preference judgments for landscapes are regressed on several dimensions of known levels, thereby providing a policy. Policies obtained from several individuals may then be clustered to obtain composite policies. This methodological approach has not been used until recently (Propst 1979) for the analysis of visual configurations. Both approaches can be useful in developing theories of landscape preference and in producing scenic utility surface topographies.

Multidimensional Scaling

Multidimensional scaling (MDS) is a procedure that can be used for determining the dimensions that individuals use when comparing stimuli. In general, MDS will be a useful analytical procedure any time that an investigator (1) can develop a procedure for comparing stimuli (in terms of difference/similarity or preference), (2) has reason to believe that the judgments made about the stimuli will be based on more than a single dimension and (3) is not certain what dimensions individuals will use in making comparison judgments.

Scaling stimuli using multidimensional analysis is similar to both factor and discriminant analysis and is based on the same mathematical models (Nunnally 1978). Because the mathematical models are complex and numerous MDS methods are available, no attempt will be made to describe the calculations explicitly. Interested readers are directed to Torgerson's (1958) classic test, to Shepard et al. (1972) or to Nunnally (1978) for a general overview of MDS. There are several reasons why MDS may be preferable to other data reduction or clustering techniques for use in landscape preference research. Since the respondent is simply asked to judge how similar the stimuli are, predesignation of the dimensions by the researcher is avoided. This may be particularly beneficial in landscape preference research where one of the goals is the discovery of relevant dimensions. In addition, the demands placed on respondents in terms of the types of judgments required are kept to a minimum, although this advantage is partially offset by the number of judgments required (as discussed below).

The objective in MDS is to produce by scaling analysis a representation of the perceived characteristics of the landscape. In order to determine the dimensionality of a set of photographs, respondents would be asked to indicate the degree of similarity between pairs of stimuli. For example, assume the investigator has 10 representative photographs of the landscapes of interest. Each respondent would, then, view all possible pairs (N = 45) of photographs.[4/] It is assumed that respondents' judgments of landscape similarity are a function of the characteristics or dimensions that distinguish the landscapes. One also assumes that the respondents are capable of providing metric judgments about the proximity of the stimuli directly. In fact, the measurement scale used by the respondents can range from ratio to ordinal with relatively little difference in interpretation (Nunnally 1978). Even though the measurement scale used does not substantially affect dimension interpretation, interval scaling of judgments allows the

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[4/] Nunnally (1968) indicates that most demonstrations of MDS have been limited to fewer than 20 stimuli. Only when the landscape stimuli are the only ones of interest - i.e., you are not interested in generalizing beyond these stimuli - would this few stimuli be adequate.

researcher to use more powerful statistical techniques when dimension values are used for subsequent analyses.

The results of these complex numerical analyses can be quite straightforwardly presented in a visual display. The dimensions of the photographs, as recovered by the scaling analysis, can be presented as a cognitive map (usually geometrically represented in euclidean space) much as a map locating cities in the United States can be constructed by knowing the longitude and latitude of each city. Figure 2 presents a hypothetical two-dimensional visual display of a cognitive map for a group of respondents (ignore for the moment the arrow). Of course, the photographs may contain more than two dimensions, in which case visual maps of each pair of dimensions may be produced showing the location of each photograph with respect to each combination of dimensions. Photographs that are far apart are dissimilar; those close together share common characteristics.

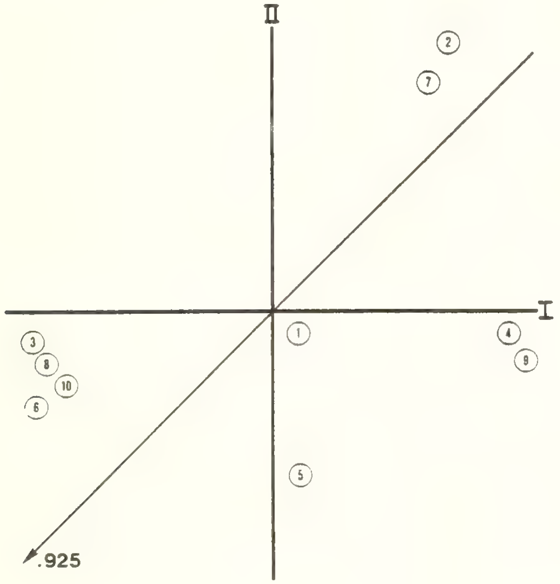

Figure 2. Dimensions I and II of the scaling solution for all respondents. The arrow travels toward the highest perceived surface topography.

The names of the dimensions may be determined from a careful inspection of the maps. For example, to define the horizontal axis or dimension I, the investigator would compare photographs 3, 8, 10, and 6 with photographs 4 and 9 since these clusters are maximally separated on this dimension. When obvious differences are present between these two clusters of photographs, the underlying feature(s) on which they differ may be proposed as the name of the dimension. The same rationale may be applied to naming the other dimensions. The similarity to factor labeling is obvious.

Up to this point the assumption has been that the investigator is not certain about the underlying dimensions of the landscapes. The researcher may, however, have a hypothesis about one or more of the dimensions based on previous findings, intuition, or some specific characteristic(s) of interest. For example, research evidence might indicate that the amount of surface variation affects judgments of landscapes. If this were the case, the investigator could include this hypothesis in the procedure by asking respondents also to make judgments about this feature of the photographs (features of the photographs might also be evaluated in a more objective fashion - e.g., grid analysis). The MDS analysis can now be related to the respondents' judgments of topographic variation because it is assumed that the same characteristics that produce similarity judgments also determine the perception of topographic variation.

The investigator now has a map representation of the photographs and perceptions of the amount of topographic variation. It is now possible to perform a correlational analysis relating the photographic dimensions issuing from the MDS to the perceived amount of topographic variation. This analysis can be visually represented by drawing an arrow through the map indicating the direction of increasing topographic variation (fig. 2). The further a photograph lies in this direction, the higher is its judged topographic variation. The direction of the arrow is determined by the correlations between the dimensions of the map(s) and the topographic variation judgments. This analysis results in an importance (beta) weight for each dimension as well as an overall multiple correlation. The squared multiple correlation is a measure of how much of the variance of the surface topographic judgments can account for all the dimensions combined. In the hypothetical example shown in Figure 2, the squared multiple correlation is indicated in parentheses at the tip of the arrow and shows that topographic variation is indeed an important variable for these photographs.

The preceding example provides an illustration of how MDS can be used to provide cognitive maps of landscapes and how the dimensions may be interpreted. Multidimensional analysis has several disadvantages that have limited the growth of its use, however. As noted previously, the number of stimuli needed to map accurately the dimensions underlying a class of stimuli would make the judgment task beyond reason for a respondent if many stimuli were needed (all possible pairs of 50 stimuli require 1,225 similarity judgments). When the occasion arises that a large number of visual stimuli is necessary to represent adequately landscape features, it is possible to have each respondent make judgments on a systematic subset of stimuli. The number of respondents should, however, be increased accordingly. Certain assumptions, as previously discussed, must also be made concerning the types of psychophysical responses required of respondents. Judgments made on an interval scale are not difficult for most respondents providing the scales are adequately anchored. Nevertheless, the researcher who can surmount these problems may well benefit from the results.

Policy Capturing

Much of the research in human judgment and information processing has concerned the way individuals weight and integrate available information into a decision. An individual's strategy for information integration, or "policy," can be mathematically represented in a procedure known as policy capturing. Policy capturing has been successfully used in a variety of applied decision-making situations including judgments made by medical pathologists (Einhorn 1974), performance appraisal and evaluation (Anderson 1977, Madden 1963, Robinson et al. 1974, and Taylor and Wilsted 1974), and graduate admission policy (Dawes 1971, Keely and Doherty 1972) to name a few.[5/] Regardless of the application, the use of the technique has resulted in useful descriptions of individual cue weighting policies.

A brief example will serve to illustrate the process through which we might mathematically represent an individual's preference judgments for landscape. Consider a situation where an individual is presented a series of stimuli each of which has been assigned a value for a number of different dimensions related to landscapes (e.g. topographic variation, contrast among elements). The individual's task is to examine and rate his overall preference for the stimulus. The preference ratings are then used as a criterion score where the dimension values are the predictors. Once this information is available, zero-order correlation coefficients and a multiple regression equation can be obtained for the individual. The raw score regression weights define the individual's hyperplane (assuming linear models) depicting the relative importance of the dimensions. The resultant R^2 indicates the degree to which the dimensions account for the total variance in the individual's policy.

The preceding example demonstrates how an individual's policy may be determined. The same stimuli may be presented to a number of individuals and policy equations determined for each. Mathematical descriptions of individual policy may then be clustered to provide a composite policy for all individuals. The Judgment Analysis technique (JAN) developed by Christal (1963) groups individual policies according to the homogeneity of their regression equations. It accomplishes this by first comparing all possible, N(N-1)2, pairs of equations to find the most homogeneous equations to use for reducing the number of equations from N to N-1. This step is repeated with each iteration reducing the number of equations by one while retaining separate equations for all remaining policies and thereby minimizing the loss in predictive efficiency at each iteration. The JAN program produces a squared multiple correlation for the composite equation plus a squared multiple correlation for each remaining equation at each iteration until the individual policies have all been included in a composite policy. Inspection of the difference in multiple correlation from one grouping iteration to the next aids in deciding the number of policies to use. The greater the loss in predictive efficiency between iterations the stronger the evidence that more than one policy equation is needed to describe the relationship.

Policy Capturing offers several advantages as a tool in landscape research and management. At a practical level, the task itself is easy for respondents to understand and to perform. Propst (1979) was able to obtain one hundred landscape preference judgments from respondents in less than 30 minutes. The R^2 values issuing from this technique also provide estimates of individual judgment reliability and the ability of the dimensions to account for overall preference judgments (when the policies are clustered). Theoretically it offers an approach that is able to resolve, at least partially, the mixed results issuing from research on individual differences in landscape preferences. The capturing of individual policies and subsequent clustering of these policies into homogenous groups provide a basis for evaluating the nature and extent of individual differences.

APPLICATIONS TO RESEARCH AND MANAGEMENT

One of the biggest problems facing researchers has been the identification of relevant

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[5/] Numerous applications of the technique may be found in review articles by Slovic and Lichtenstein (1971) and in Slovic et al. (1977).

physical landscape elements that can be used in modelling preferences. Previous investigations have turned up several apparently predictive variables such as amount of water, man impacted area, insect damage and amount of downed wood, Quite often these dimensions, which were uncovered by quantitative trial and error, proved to be very predictive in empirically derived linear and non-linear equations (Shafer et al. 1969; Arthur 1977; Buhyoff and Leuschner 1978; Jackson et al. 1978). The use of such techniques as MDS and Policy Capturing may provide the necessary insight about dimension weighting and interaction so that rational mathematical models may be stipulated a priori (Guilford 1954). It is possible that certain types of landscape elements behave in non-coincidental interactive ways so that "standard" utility surfaces can be generated for a given subset of salient elements. Through this type of research, applied in different physiographic regions with a broad variety of subjects, we may gain information which will permit the formulation of substantive landscape perception theory.

While many of the empirical models in the literature are linear formulations, there is some indication in our own research that nonlinear forms may be more appropriate. Therefore, we may find what economists already know about consumer utility analysis; that is, constant increases in the quantity of goods are not associated with constant increases in utility. It is reasonable to assume that landscape perception may occur in a similar manner. Of course, as we stated before, we cannot treat a landscape scene as a single dimension. Landscapes are a collection of elements or goods which are perceptually "consumed." For this reason, we need to specify the nature of the interactions between elements, thus producing scenic utility surfaces. Policy Capturing and MDS methodologies can aid in the investigation of this hypothesis.

Guidelines for the management of the visu resource issue directly from the determination of the relative importance of dimensions in landscapes through MDS, Policy Capturing or other techniques. To illustrate, we will use Buhyoff and Leuschner's (1978) Southern Pine Beetle (SPB) study as an example of how visual guidelines can be used to aid management decisions. Suppose, instead of making preference judgments based only on SPB damage, that the scenes also hypothetically varied with respect to another perceptually salient dimension of t ography. These two dimensions, amount of insec damage and an index of topography, may combine to produce a non-linear surface which would result in decisions divergent from those based on either dimension viewed by itself (fig. 3). Consider points A, B, and C on this hypothetic surface. Point A shows that preference (scen utility) is at a minimum when SPB damage is hi and the topographic index is minimal. However point B indicates that preference increases wh both the SPB damage and the topographic index are high. Thus, we would make a faulty prediction of low scenic utility for a landscape wit a large amount of SPB damage and a high topographic index by using a simple two-dimensiona model relating only X to Y. Management decisions for point C would not differ from those based on either the amount of SPB damage or th

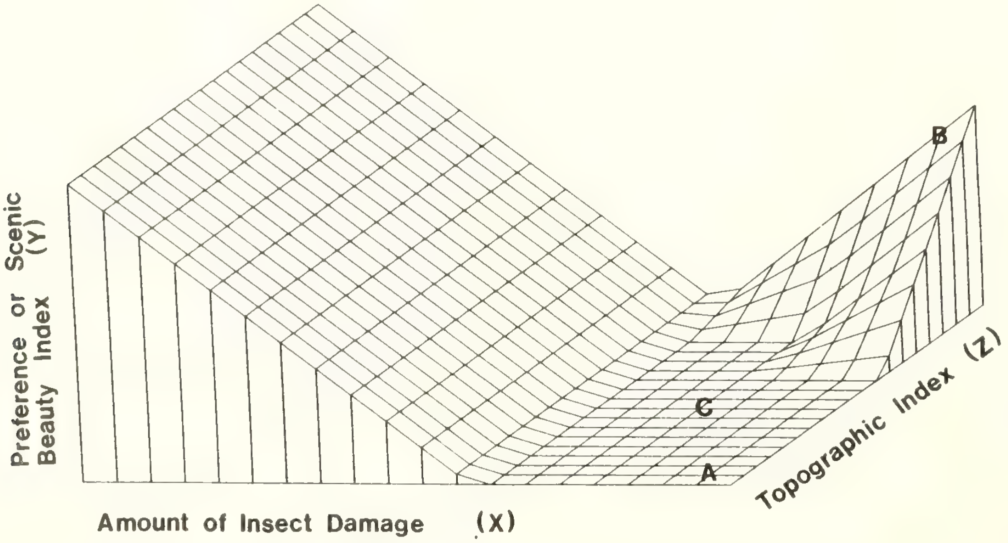

Figure 3. A hypothetical three dimension scenic utility surface.

topographic index. We also observe that point C is surrounded by a relatively large flat portion of the scenic utility surface. It follows, then, that if a given landscape were in the condition described by point C, small changes in either or both dimensions would not change the overall utility. Scenic utility surfaces may provide a means for judging the overall efficiency or cost-effectiveness of landscape modifications. The point is that preferences are seldom a function of a single feature of the environment and that several characteristics may combine in a complex fashion to produce optimal management guidelines. In fact, landscape management guidelines may well be set by the ridges, depressions and plateaus of scenic utility surfaces.

Our three-dimensional surface example may seem simplistic. However, it was necessary to deal with this type of illustration to make our point. In fact, it is not important that the surfaces be drawn if more than 2 landscape dimensions are used. The surface topography can be described and characterized mathematically, and management guides can be set just as easily.

CONCLUSION

The preceding sections have shown how MDS and Policy Capturing can help the investigator both to identify the relevant dimensions in landscapes and evaluate their relative importance in "causing" fluctuations in measures of scenic utility. The two techniques can provide unique, yet complementary information about landscapes which may direct us to the next step of theory formulation. MDS can aid the researcher in recovering preference or scenic beauty dimensions without forcing individuals to cue on specific dimensions. Dimensions so recovered may be quantified for use in Policy Capturing to provide estimates of their relative importance. Conversely, a researcher may begin with known or hypothesized dimensions and examine their relationships to dimensions issuing from MDS or their relative importance to preference or scenic beauty through Policy Capturing. At the very least these techniques offer alternatives that can provide a semi-basis for establishing the validity of constructs currently used to assess landscapes.

The intent of this paper was to outline a basic methodological approach for deriving scenic utility functions to be used in landscape assessment strategies. Techniques such as MDS and Policy Capturing may provide the means for stipulating a priori the salient manageable landscape elements which are used by people in their perceptual determinations of preference, utility, or scenic beauty. We have advanced a hypothesis about the existence of "standard" or "common" scenic utility surfaces -- that is, the existence of mathematically describable landscape element interactions. If such utility surfaces exist, then we may be provided some empirical information useful in theory construction. At a minimum, however, even locally specific scenic utility functions provide a logical means of formulating scenic management guidelines and estimating management efficiency and/or cost effectiveness.

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Visual Perception of Landscape: Sex and Personality Differences[1]

A. Maciá[2]

Abstract: The present study established relationships between individual differences and subjective evaluation of different kinds of landscapes. These were the first three principle components of the five components obtained from a matrix of coincidences. The three components used were: 1) natural versus humanized landscapes; 2) pleasant versus rough landscapes; 3) straight and neat forms versus round and diffuse forms. The subjects were taken from male and female university students. These subjects completed several psychological tests: CEP, 16PF and Embedded Figures Test. The data obtained from these tests were correlated with the components of the ecological test. The following hypotheses were presented for, and supported by the research that was carried out: 1) Personality structure conditions the choice of landscape; 2) the sex variable can influence landscape preference. This influence can be direct or influenced by personality factors.

INTRODUCTION

Defining landscape is not an easy task. The number of definitions that exist is proof of this. For example, the Spanish Royal Academy of Language considers landscape as: 1) Painting or drawing that represents a certain extension of land; 2) a portion of land that is considered in its artistic aspect.

Landscape is an inserted reality in human life that humans suffer from and enjoy daily. The environment is not landscape until people perceive it. Therefore, the methods of assessment, and even of description, can't be free from a certain degree of subjectivity.

Assessing landscape is a primordially subjective realization in which the perceiver's point of view, as well as that of the ecology in which the landscape is inserted, must play a part.

If people are an essential factor in the concept of landscape, psychological studies of the personality determinants, sex and age, are of elemental interest in its evaluation. This is so since it would bring us to a more complete scientific focus of the ecological-psychological-social structure of landscape. For without people, nothing more than nature would exist. This study would give the ecologist, architect, landscape architect, etc., objective facts about his own evaluation, which could be contrasted in an objective form with that of others.

Foundations exist for supposing that there are personality, sexual and cultural differences in the perception and appreciation of landscape. Perhaps the clearest example that we find is in the design of gardens. The comparison between English, French, Arab or

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Japanese gardens can be an exponent, not only of the ecological or environmental differences but also of the cultural differences of peoples. The only problem that can exist is in discerning which is the cause and which is the effect. What is evident is that the relationship exists, and that people can influence the medium at the same time that this medium influences them. Even at the simplest level of theoretical analysis, the biological, the influence of the surrounding stimuli in the development of the central nervous system, is demonstrated, as was done by Rosenzweig *et al*. (1960). Or, as Piaget (1967) would say, man and all living beings in general, move on the Earth, transforming it, and modifying themselves by the action of their transformations; understanding that "adaptation" is an equilibrium between "assimilation" (or the action of the living being over his surroundings) and "accommodation" (or the inverse action, that the living being never suffers in a passive form).

In psychology, studies about perception and perceptual laws are very developed since they are concerned with one of its principle areas of interest.

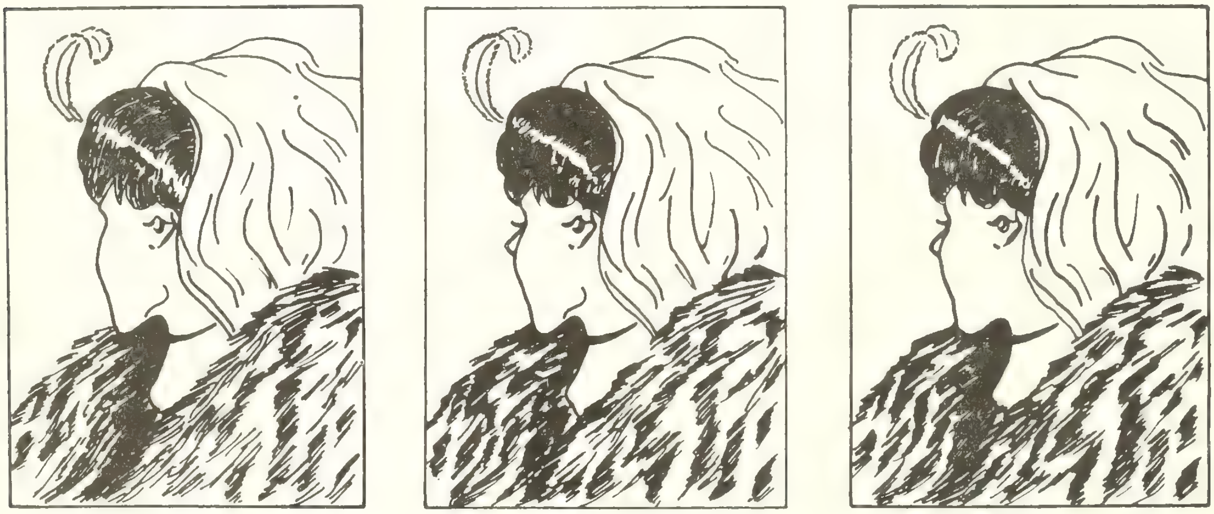
According to Fdez. Trespalacios (in press), in the animal kingdom, all manifestations of life can be analyzed according to three levels: biochemical, physiological and behavioral (intimately related). We can frame perception at the behavioral analysis level, considering it as the response to a configuration of stimuli.

It is convenient, at this point to make a distinction between sensation and sensation concepts. As Hebb (1968) says, sensation can be defined by saying that it is the activity of the sensory receivers as well as the activity resulting from the afferent canals to the corresponding cortical-sensorial region that it includes. On the other hand, perception would be the activity of the mediator processes induced by sensation. A mediator process is the configuration and analysis that the nervous system makes of the sensory stimuli that permit the construction of a meaningful world.

A sample of the complexity of perception from sensation can be seen in figure 1. This shows the distinct possibility of configurational arrangement from the same sensation (Hebb, 1968).

In conclusion, if we want to give a psychological concept or definition of perception, we have to say, along with Prof. Fdez. Trespalacios (in press), that it is a process by which the human organism informs itself about objects and the processes that are exhibited in them, via the sensorial configuration of informative stimuli.

The influence of experience and learning on the perceptual process has also been studied in this sense by behavioral psychology, the polemic remaining somewhat confused in the results; even though clear indications seem



Old Woman

Ambiguous Perception

Young

Figure 1--The distinct possibility of configurational arrangement from the same senation (Hebb 1968, p.102).

to exist that a determining factor in perception is the possible significant loading of the stimulus, and that this meaningful connotation can be determined by learning or the previous experience of the subject. It could also be so because of the motivation produced by individual personality differences.

For its part, differential psychology has centered its interest on what relates to perception. This includes the perceptive differences between individuals of distinct cultures, above all in the field of optical illusions. That is, phenomena of visual perception that aren't reflected in the stimulation model, and of which the form is therefore independent from presented stimulus.

There are also studies that have tried to relate perception methods with personality types. Witkin et al. have analyzed the subject's perception and personality, dividing them into "field-dependent" and "field-independent" (in that which refers to perception). The "field-dependent" subjects tend to be dominated by the visual field if it is in conflict with other perceptions. The studies and investigations carried out to prove Witkin's theory are numerous, obtaining highly significant results. Literature pertaining to this can be found in several bibliographic information bulletins (Witkin, Oltman, Cox et al. 1973), and in three bibliographic supplements which appeared in 1974, 1976 and 1978. The research treats very diverse fields: drugs, stress, training, sex, age, personality, pathology, etc.

In the visual perception field, multiple forms of tricky visual forms have been conceived. One of them is that which corresponds to the Embedded Figures Test of Oltman, Raskin and Witkin (1971), which deals with separating a simple figure that has been introduced in a more complex design. The efficiency of field-dependent subjects is markedly inferior to that of field-independent subjects.

Burton (1975) indicates some work that is an attempt at approximation. Sonnenfeld (1966) presents data to show that cultural, age, and sexual differences are significant at the moment of determining landscape preferences, but he maintains the idea that the degree of environmental experience and individual personality differences are of greater importance. With less success, Winkel et al. (1969), tried to relate personality factors with the evaluative response of the individual to a design of the surrounding of a highway. No study has yet been able to establish the relative importance of personality and social factors in the variations of landscape evaluation.

In this line is the investigational work which we have carried out, with the object of relating personality factors with the individual's preferences to determined types of landscapes.

METHOD

Work Hypotheses

The hypotheses with which we set out in the present investigation are: 1) Personality structure conditions landscape preferences, and 2) the sex variable can influence landscape preferences. This influence can be direct or influenced by personality factors.

Samples Employed

The study we are explaining here was carried out with university students of the arts. The sample selection method was by conglomerates (Azorín Poch 1972, Cochran, 1975). Given that we initially had no knowledge of the population in the studied variables, the process was begun with a pilot sampling. The colleges or sections sampled at random were: psychology, language and literature, and geography and history. Once this step was completed, we proceeded to take the definitive sampling. A total of 226 subjects make up the sample, 142 women and 84 men.

Tests Employed

1. Ecological test:

A series of 15 slides of pairs of landscapes in photographs or drawings has been presented to the subjects, with a 5-second cadence. The test consists of choosing, in each pair, the one liked best, circling on the appropriate sheet that was provided, the "L" or the "R," depending on whether the left one or the right one was preferred.

The series of photographs or drawings we used to evoke reactions to landscape from the subjects (considering, naturally, that notable differences are contained with an evaluation process of real landscape) has been taken from the doctoral thesis of Sancho Royo, directed by Prof. González Bernáldez, and in turn is the result of previous investigations. (González Bernáldez, Sancho Royo et García Novo 1973, Sancho Royo 1974, Sancho Royo, Gonázlez Bernáldez y García Novo 1972).

In the cited thesis, a block of 60 pairs of photographs or drawings of natural landscapes was used, and when the responses were obtained a correspondences analysis and a principal components analysis were carried out. As these proved not to be useful, a new method was proposed, coincidence matrix. Five principal components were obtained from this one. In the present paper we will refer only to the first three components, as these explain an elevated percentage of the total variance and seem to have a better interpretation:

> Component I--This manifests polarity between unaltered, natural landscapes and humanized, artificial landscapes; this means a polarity between those without apparent human influence, whose elements are disordered, against very humanized landscapes, with a regular disposition of elements - farming, houses, etc.
>
> Component II--This refers to the polarity between pleasant, sheltering, gentle landscapes contrasted to rough, inhospitable ones. The differentiating characteristic is mainly concentrated in the degree of vegetational cover.
>
> Component III--This presents a polarity characterized by two fundamental notes - straight, neat forms versus round, diffuse forms.

For each of these components, we chose the five pairs of landscapes with the highest saturation in each component and practically no saturation in the other components.

2. Psychological Tests:

As for psychological tests, the following have been applied: two personality questionnaires, the CEP and the 16PF, and a perceptive test.

Prof. Pinillo's CEP personality questionnaire "is without doubt the best known and most utilized by Spanish psychologists... . The test, principally edited by the Spanish Institute of Applied Psychology, was conceived by its author, taking into account some already existing questionnaires, such as Guilford's STDCR...and the F and L scales (sincerity and stability) of the MMPI questionnaire." (TEA 1974).

The questionnaire is composed of five scales: control, extroversion, paranoia, sincerity and amount of doubts. Norms exist for application to sample from both sexes of professionals and students. Its application can be individual and collective, and its scop of application is from 14 to 15 years and olde and for all cultural and professional levels.

Cattell's 16PF questionnaire tries to giv a global vision of personality, based on the evaluation of 16 dimensions or first order factors, functionally independent and psychologically meaningful; and four second order factors. In its current form it depends on an empirical base of more than ten factorial investigations of several thousand elements. It is designed to be applied to adolescent and adult subjects. It is presented under six forms: A/B, C/D and E/F. The A/B forms have 187 items. These forms are the only ones adapted in Spain which are applicable to subjects with an educational level that is superior to the Superior Bachiller Level (high school).

In respect to the perceptive test, the Oltman, Raskin and Witkin "Embedded Figures Test" which we have spoken of previously has been applied.

3. Socio-economic questionnaire:

In this questionnaire, which we elaborated, we try to measure, in an approximate form, the economic and family level. In order to do this we ask for the father's, or the mother's occupation. The cultural level of the family is approximated by asking about the level of the parents' completed studies.

This has been done in this somewhat informal manner since the socioeconomic level doesn't make up a fundamental variable to study But we think that it should be taken into account and we should have some approximate information about it.

Statistical Treatment of Data

At the moment of interpreting the amount of information that all these tests gave us, one must choose the most suitable statistical method so that everything can be adequately analyzed without loss of information. In this paper we are going to explain the results obtained with the Hotelling T^2 test and the Canonical Correlation Analysis (Dagnelie 1975, Cooley and Lohnes 1971, Tatsuoka 1971).

Results

Once the tests were completed and the results obtained, we analyzed if the women and men had the same vector of averages in the studied variable. The results are presented in Table 1. Data confirm notable sexual differences.

Table 1--Differences between men and women.

T^2 Hotelling	F	D.F.	Signific.
533.6623	13.8623	33 192	0.000

Analyzing each of the tests separately, significant differences appear in many of them; thus, there are differences in control variable of the CEP with $t=3.87 (p<0.000)$, a favorable difference for the men; the men also had more emotional stability (C factor of the 16PF) with $t=5.28 (p<0.000)$; the women had a more depressive personality (O factor of the 16PF) with $t=2.54 (p<0.01)$; the men had more anxiety (QI factor of the 16PF) with $t=3.85 (p<0.000)$, etc; all their differences in the personality variables and in the Embedded Figures Test gave a $t=2.23 (p<0.027)$; while no significative differences appear at the moment of choosing landscapes.

If we observe the correlation matrix between the personality variables and the landscape components, carried out with all the subjects, there are many significant correlations (table 2). Of these we can cite:

1. Negative correlation between CEP scale E and Component I of the landscape test. The subjects with high scores for social extroversion prefer humanized landscapes and vice versa, $r=0.136$ ($p<0.05$)

2. Negative correlation between CEP scale C and Component II-the subjects that score high in emotional control prefer pleasant landscapes, $r=-0.23$ ($p<0.01$)

3. Positive correlation between CEP scale C and Component III-the subjects with high scores in emotional control prefer landscapes with rounded trees and diffuse forms, $r=0.352$ ($p<0.01$).

If we separate the men from the women and we obtain their correlation matrix separately, we see that many of the significant correlations that were presented when they were together stop being so, while other new ones appear, although some of them remain the same (table 2). Looking first at the men, some of the significant correlations are:

1. Negative correlation also appears between 16PF factor C and Component I. Men with mature personalities who deal with reality, prefer humanized landscapes, $r=0.427$ ($p<0.01$).

2. Negative correlation between CEP scale C and Component II-men who score high in emotional control prefer pleasant landscapes, $r=0.543$ ($p<0.01$).

3. Positive correlation between CEP scale CEP and Component III, as occurred with all subjects together, $r=0.236$ ($p<0.05$).

Table 2--Significant correlation coefficients between landscape and personality.

	Men and Women		Men		Women	
Significance	$p<0.01$	$p<0.05$	$p<0.01$	$p<0.05$	$p<0.01$	$p<0.05$
IA Natural Landscape	16PF: I 0.177 QIII 0.182	CEP: E -0.136 16PF: C -0.138 N 0.139	CEP: C -0.289 16PF: C -0.427 E -0.398 QII-0.363		16PF: I 0.228 QIII 0.227	16PF: N 0.214
IIA Dry, cold Landscapes	CEP: C -0.230 16PF: E -0.252 G 0.197 QIII 0.209	16PF: B 0.161 C -0.171 I 0.142 N 0.173 QII -0.139	CEP: C -0.543 16PF: C -0.595 E -0.593		16PF: G 0.233 N 0.233 QIII 0.300	CEP: P -0.209 16PF: B 0.200 H -0.188 I 0.193 Q3 0.178
IIIA Diffuse Forms and Rounded Trees	CEP: C 0.352 16PF: C 0.250 I -0.263 N -0.219 O 0.236	CEP: E 0.158 P 0.152 16PF: F 0.150 QIII-0.160	16PF: I -0.482 O 0.571	CEP: C 0.236 P 0.229	CEP: C 0.415 16PF: C 0.340 F 0.219 N -0.310	CEP: E 0.183 16PF: Q1 -0.215 Q3 -0.190 QIII-0.195

If we take the correlation matrix of the women, some of the significant correlations are:

1. Positive correlation between 16 PF factor I and Component I-women who scored high for a sensitive, insecure personality prefer natural, unaltered landscapes, r=0.228 (p<0.01).

2. Positive correlation between 16PF factor N and Component II-women with astute, worldly personalities prefer dry, cold landscapes, R=0.233 (p<0.01).

3. Positive correlation between CEP scale E and Component III-women with high scores for extroversion prefer landscapes with diffuse forms, r=0.183 (p<0.05).

With respect to the results of the Canonical Correlation Analysis, these results appear in table 3. Here we can see that the results change considerably by obtaining them from all the subjects or doing them with men and women separately. In what refers to landscap the major weights of the canonical variables are in Component III for the first canonical variable and in Component II for the second one when all the subjects are dealt with. When only the men are considered, the weights change, the major one being that of Component II for the first canonical variable and Component III for the second one. With the women, the weights that we found when analyzing all the subjects together are repeated.

DISCUSSION

We found, therefore, as we predicted in the hypotheses, personality structure conditions the choice of landscapes, since there are significant correlations in the separate analysis of the variables in the correlation matrices, and also when we employed the canonical correlation analysis.

Table 3--Canonical variables coefficients between landscape and personality questionnaires

	Men and Women		Men		Women	
	1 Canonical variable	2 Canonical variable	1 Canonical variable	2Canonical variable	1Canonical variable	2Canonica variabl
Set 1 Landscape						
IA	-0.026	-0.255	-0.021	0.652	0.012	0.297
IIA	0.046	1.188	1.018	-0.686	0.323	0.850
IIIA	1.007	0.305	0.604	0.846	1.078	0.118
Set 2 Personality						
C	0.460	-0.358	-0.232	0.541	0.391	-0.088
E	0.102	0.266	-0.124	-0.441	0.252	0.116
P	0.354	-0.070	0.102	0.132	0.267	-0.376
S	-0.217	0.019	0.046	-0.267	-0.221	0.154
?	0.112	-0.044	0.018	0.087	0.002	-0.018
A	-0.077	-0.240	0.151	0.134	-0.285	-0.286
B	-0.165	0.252	-0.075	-0.248	0.010	0.282
C	0.219	-0.059	-0.432	-0.110	0.219	-0.104
E	-0.240	-0.468	-0.457	0.401	-0.237	0.210
F	0.162	0.280	-0.026	0.083	0.227	0.229
G	0.106	0.640	0.199	-0.358	0.278	0.276
H	-0.175	-0.258	0.069	0.250	-0.341	-0.433
I	-0.183	0.083	-0.057	-0.480	0.054	0.458
L	-0.243	0.103	-0.104	-0.422	-0.133	0.144
M	-0.013	-0.298	0.092	0.207	-0.025	-0.147
N	-0.308	0.159	0.010	0.027	-0.355	0.200
O	0.439	0.097	0.599	0.467	0.098	-0.203
Q1	-0.191	-0.276	-0.036	-0.038	-0.202	-0.138
Q2	0.057	-0.048	-0.103	-0.243	0.078	-0.102
Q3	-0.347	0.063	0.029	-0.115	-0.345	0.062
Q4	-0.113	-0.396	-0.116	0.191	-0.029	-0.172
QI	0.020	0.115	-0.083	0.125	-0.059	-0.121
QII	0.051	-0.221	0.088	-0.392	0.155	0.096
QIII	-0.025	-0.343	-0.220	0.245	0.024	0.335
QIV	0.250	0.199	0.029	0.307	0.010	-0.022
Canonical Correl.	=0.602	=0.478	=0.845	=0.732	=0.655	=0.554

On the other hand, the second hypothesis as also supported. We observed that though here were significant correlations in both orms of analysis, joining men and women and eparating them, the correlations changed, and hose correlations, significant in one form of nalysis, were not the same as in the former ne.

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Technology Available to Solve Landscape Problems— Session D: Evaluation of Visual Assessment Methods

Appraising the Reliability of Visual Impact Assessment Methods[1]

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Abstract: This paper presents the research approach and selected results of an empirical investigation aimed at the evaluation of selected observer-based visual impact assessment (VIA) methods. The VIA methods under examination were chosen to cover a range of VIA methods currently in use in both applied and research settings. Variation in three facets of VIA methods were investigated: (1) the descriptive landscape attributes which serve as the basis for ratings; (2) the rating procedure employed; and (3) the mode of landuse activity simulation. Research participants consisted of USDI Bureau of Land Management (BLM) staff and university environmental planning and management students with prior VIA training. Research participants were assigned to one of three experimental groups, with each group rating 35 mm photo slide representations of 4 scenes using some combination of the various rating procedures. The scenes employed are representative of typical landscapes and landuse activities in BLM's administrative jurisdiction. Reliability coefficients for the various rating methods are presented. Observed trends in the reliability coefficients indicate that reliabilities are: (1) low for ratings based on small numbers of observers; (2) higher for ratings of scenes before the imposition of landuse activity impacts than for ratings of scenes after the imposition of impacts; (3) higher for direct ratings of landscape attributes than for ratings of the degree of contrast, or change, imposed upon landscape attributes by landuse activities, and (4) higher for BLM's visual contrast rating method when the visual impact is simulated by photographic representation rather than brief verbal descriptions and artists' sketches.

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The goal of Visual Resource and Impact Assessment (VRIA) is the provision of systematic and objective information concerning the visual quality of landscapes and the visual impacts of landuse activities pertinent to decisionmakers charged with land resource management (Brush 1976; Craik 1970, 1971, 1972; Craik and Feimer 1979; Craik and Zube 1976; Litton 1968; Zube, Brush and Fabos 1975). A fundamental assumption underlying the inclusion of such methods in the decision-making process is that more effective and judicious management practices will result. However, that assumption can be correct only if the quality of information generated by VRIA methods is acceptably high. Effective decisions are possible to the degree that the information upon which they are based is both accurate and appropriate to the issues at hand.

The nature and quality of information generated by VRIA methods can be appraised by standard psychometric indices (Craik and Feimer 1979, Daniel 1976). Although a number of measurement issues are of fundamental importance in that regard, none is more basic than the question of reliability. Most simply, the reliability of measurement provides an index of the consistency and precision with which a measurement instrument performs. A reliable instrument will yield consistent results upon repeated attempts to measure a particular attribute under relatively equivalent conditions and will accurately reflect systematic variation of the attribute in question under varying conditions.

In the context of observer-based VRIA's, the issue of reliability concerns the degree of agreement attainable from independent judgments of specified landscape attributes (Craik and Feimer 1979, Daniel and Boster 1976). These independent judgments may be made by the same individuals rendering their judgments at two different times, in which case a measure of intra-observer reliability is obtained, or they may be judgments made by persons independently and subsequently compared to one another, in which case a measure of inter-observer reliability is obtained. Estimates of both intra-observer and inter-observer reliability are desirable, but an estimate of inter-observer reliability is especially important in evaluating observer-based VRIA methods since the scope of comparability in judgments among individuals defines the attainable level of objectivity of the measures in question.

The empirical evidence concerning inter-observer agreement indicates that relatively high reliability (e.g., reliability coefficients as high as .7 - .9 on a 1.0 scale) is obtained when (1) the coefficients are based upon the degree of agreement between composite ratings of 2 or more panels with 10 or more judges per panels (Brush 1976; Craik 1972a; Shafer and Tooby 1973; Zube 1973, 1974; Zube, Pitt and Anderson 1975), or (2) when multiple scenes representative of target areas are rated by every observer and the composites for each area are employed in obtaining the reliability estimates (Daniel and Boster 1976).

Although it is reassuring to know that the reliability of scenic quality and related descriptive attributes can be relatively high when multiple composite ratings are obtained, the plausibility of obtaining such composite ratings is somewhat limited in the day-to-day context of VRIAs. The manpower allocation of 5 or more observers to evaluate the same area from multiple perspectives is normally reserved for major developments, such as the siting of nuclear power plants, large-scale oil exploration and major utility corridors. For more frequently occurring and mundane VRIA problems, such as pipeline and tank siting, small scale mining, and brush to range conversion, one or two field technicians may have the task of carrying out the pertinent VRIA procedures from the vantage point of the nearest access road. Under these conditions the reliability of the obtained indices cannot be expected to be as high as it is under conditions permitting a large number of raters to evaluate an area from numerous perspectives. The reliability of indices based upon multi-rating composites will almost inevitably result in reliabilities far in excess of unitary ratings (Guilford 1954; Nunnally 1978). Nonetheless, the need for the establishment of psychometric standards under non-optimal assessment conditions must also be of concern. Although the landuse activities being evaluated under those conditions may not singly constitute major landscape intrusions, by virtue of their more frequent occurence they have the potential for compounding their effect on the landscape over time and thus, in the long-run, can be just as detrimental to scenic quality as the initially more attention-getting single large-scale impacts.

The research to be reported here appraises the reliability of selected Visual Impact Assessment (VIA) methods which can be applied under site specific conditions with varying numbers of observers. It is part of a more comprehensive research project being carried out in cooperation with the U. S. Department of Agriculture's Forest Service and the U. S. Department of the Interior's Bureau of Land Management to evaluate VIA methods relevant to use within those agencies.[5] A technical evaluation of the U.S.D.I. Bureau of Land Management's (BLM) Visual Contrast Rating (VCRM; U.S.D.I., Bureau of Land Management 1975) has been a primary goal of the undertaking.

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METHOD

Selection of VIA Methods

A review of the literature on observer-based VIA methods reveals considerable variation in three facets: (1) the descriptive landscape attributes which serve as the basis of ratings; (2) the rating procedure enlisted, including instructional sets for attending to the landscape representation and recording responses; and (3) the form of simulation employed to depict changes in the landscape. Variations in each of those VIA system facets were selected for study in the current research project based on their prevalence in either application or the research literature, and their promise for ease of incorporation into active VRIA programs dealing with a wide range of both large and small scale landuse applications.

Descriptive Attributes

Thirteen environmental descriptors applicable to general evaluation of landscapes and 2 descriptors applicable directly to impact evaluation were examined. The general landscape descriptors include: *ambiguity*, *color*, *compatability*, *complexity*, *congruity*, *form*, *intactness*, *line*, *novelty*, *scenic beauty*, *texture*, *unity* and *vividness*. The impact evaluation descriptors were *importance* (of an element) and *severity* (of visual impact). *Color*, *form*, *line* and *texture* were included because of their use in BLM's VCRM (USDI, Bureau of Land Management 1975), as well as in other VRIA systems (e.g., Litton 1968, 1972; USDA, Forest Service 1974, 1975, 1977). *Importance*, *intactness*, *unity* and *vividness* were abstracted from the work of Jones and his colleague's (Jones *et al*.1975). *Scenic beauty*, as a general index of visual quality, was drawn from the work of Daniel and his colleague's (Daniel and Boster 1976; Daniel *et al*.1977; Schroeder and Daniel in press). *Ambiguity*, *compatability*, *complexity*, *congruity* and *novelty* were drawn from concepts developed primarily in the experimental aesthetics literature (Wohlwill 1976). *Severity* was added as a general dimension intended to assess the degree of visual impacts.

Rating Methods

A four-point 0 to 3 scale analagous to the one employed in BLM's VCRM (1975) was employed for all ratings. An ordinal scale of measurement was presumed, with the numeric values representing the strength of the quality rated. The verbal labels none, weak, moderate and strong were associated with the numeric values 0, 1, 2, and 3 respectively, in conformance with BLM's VCRM (1975).

Two rating procedures were employed. One of these entailed a direct rating of the visual representation of scenes with respect to the descriptive attributes previously enumerated. The use of these direct ratings in VIA requires independent ratings of a particular scene (a) in its unaffected state, and (b) after presentation of a landuse activity by visual or other means.

The other rating procedure entailed a rating of the degree of change, or contrast, in all of the descriptive attributes, except *importance* and *severity*, following a visual presentation of each scene both before and after the imposition of a landuse activity. *Importance* and *severity* ratings imply the rating of some element of change by definition, and thus required no additional procedural modification.

Landscape and Impact Stimuli

Scene Selection. Three primary criteria were employed in the selection of landscape scenes: (1) the representativeness of scenes with respect to general landscape types within the BLM's management domain; (2) the scenes' suitability for landuse activities that bear upon BLM's visual management concerns; and (3) the availability of photographs of suitable quality for reproduction and simulation.

BLM's land holdings are located primarily in the western portion of the United States and are quite extensive and diverse. To select representative scenes, it was necessary to develop an appropriate landscape classification. The area in question extends from the Pacific coastline, to the eastern border of North Dakota, Nebraska, Kansas, Oklahoma and Texas.

The landscape classification was based on the system developed by Litton *et al*.(1978) for the Northern Great Plains. Continuities

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Bureau of Land Management (USDA Pacific Southwest Range and Experiment Station interagency agreement nos. PSW-46 and PSW-62) and the USDA Forest Service (USDA Pacific Southwest Range and Experiment Station interagency agreement no. 36).

and provinces were identified by consulting references on physiographic and vegetative features, supplemented by color slides from a number of areas. Hammond's (1964) land-surface form classification and Kuchler's (1969) vegetation maps were the primary sources used. Thirty-six landscape continuities were identified and subsequently grouped into 10 landscape types, based upon similarities in topography and vegetation. The land-form and vegetation combinations which constitute the ten types are: rugged mountain with forest; rugged mountain with a mosaic vegetative pattern (combination of vegetation of vegetative types); combined plain and mountain with forest; combined plain and mountain with open vegetation (sparse vegetation which forms no visual mass); tableland (plateau) with forest; tableland with mosaic; tableland with open vegetation; subdued landform (flat, gentle) with forest; subdued landform with open vegetation; and, coastal continuities.

Landuse activities relevant to BLM visual management were identified through interviews with landscape architects in all BLM state offices. The most pertinent landuse activities can be characterized by nine general classes: range and agriculture; timber; water; surface mining; oil and gas exploration; power plants; utilities; roads; and, recreation. An "other" category for assorted minor landuse activities was also formed.

Nineteen scenes that characterize landscapes and landuse activities relevant to BLM and for which appropriate photographs were available were selected. However, the data to be reported here are based only upon the four scenes in Figure 1. Scenes 1 and 2 represent the landscape class consisting of subdued landform with open vegetation. The landuse activities for those two scenes are surface mining and utilities, respectively. Scenes 3 and 4 represent the landscape class comprised of plain and mountain landform with open vegetation. The landuse activities for those two scenes are water (tank and pipeline in this case) and roads.

Simulation. To evaluate the effectiveness of the various VIA methods, two visual alternatives of each scene were required, one depicting the scene before the imposition of a landuse activity (pre-impact) and one depicting the scene subsequently (post-impact). However, pre-impact and post-impact photographs of scenes controlled for observer position, lighting, time of day, season, and other variables were not available. Thus it was necessary to employ some form of simulation.

The photographs used in this study are 35 mm color slides, which were obtained from BLM state and district offices, the USDA's Forest Service, the California Coastal Zone Commission, and the files of one of the authors. Of the nineteen original photos, four depicted scenes before intrusion of a landuse activity, and the others depicted the scene after the intrusion of a landuse activity.

Simulation of pre-impact scenes was accomplished by a 3-stage retouching process. Two 7"X10" high quality color prints were made from the original slide. One of the reprints was retouched to remove the activity, using retouch dyes to darken and alter light color, and opaque water color to lighten dark areas or objects. An airbrush was used to apply water color to mask structures seen against the sky. The appearance of the landscape obscured by the landuse activity was inferred from unaffected portions of the landscape in the scene. Both the altered (pre-impact) and unaltered (post-impact) prints were then rephotographed to produce the slides used in this study.

Simulation of post-impact scenes was accomplished by painting in the landuse activity. The first and third steps of this process were the same as in pre-impact simulation. In the second step, the addition of the landuse activity was accomplished by outlining the proposed development based upon the locations of the viewpoint and activity (in one case this was done using the mosaic photomontage program), the dimensions of the proposed development, and the construction material specifications. The activity was then painted in using opaque and retouch colors.

Scenes 1 to 4, employed in the portion of the study reported here, are displayed in Figure 1.*

Research Design

To assess the psychometric attributes of the direct and contrast rating procedures under the three rating conditions (direct pre-impact rating, direct post-impact rating, and pre-impact versus post-impact contrast), two experimental conditions were employed.

Pre-Impact and Post-Impact Treatment (PRE-POST)

Research participants in this treatment condition are shown pre-impact versions of the scenes, and immediately after viewing each scene are asked to rate all of the landscape attributes previously enumerated (see Appendix A), except importance and severity.

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*See color illustration on page 391.

Next they complete part 1 of the BLM VCRM, which entails a description of the scene in terms of form, line, color, and texture, for each of three segments of the landscape: (1) land-water bodies, (2) vegetation, and (3) structure.

The pertinent landuse activity for the scene is then presented in one of two forms: (1) A single 8 1/2"x 11" sheet of paper containing an artist's black and white sketch of the site with the impacting activity added, along with a one paragraph statement concerning dimensions and construction features (e.g., composition, color and texture of building materials) of the activity; or, (2) the post-impact photo slide. Immediately after the presentation of the pertinent impacting activity for each scene, participants complete three additional procedures. First, using the four point scale previously described, respondents rate the degree of contrast the landuse activity imposes upon all of the landscape elements, except importance and severity, and then rate the importance of the landuse activity with respect to scenic quality and severity of visual impact. Second, participants complete Part 2 of the BLM VCRM, which entails a description of the landuse activity in terms of the same descriptive dimensions and landscape components previously noted for the landscape description required in Part 1 of the VCRM. Finally, participants complete Part 3 of the BLM VCRM, which entails a rating of the degree of contrast the activity generates for the dimensions of form, line, color and texture (separately for the landscape components of land-water bodies, vegetation, and structure).

Post-Impact Only Treatment (POST)

Research participants in this treatment condition are shown only the post-impact versions of the scenes. Immediately after viewing each scene participants rate it on all landscape attributes (see Appendix A) (except Importance and Severity). After completing these ratings the relevant landuse activity is pointed out, and participants are asked to rate the importance of the element in determining the scenic quality of the scene and the severity of visual impact caused by that element.

STUDY: PART 1

Participants

Research participants in this portion of the study consisted of 60 BLM staff members whose agency duties included VIA. All participants had received some training in BL VCRM. The professional specialties of partic pants in this sample are: landscape architec ture, recreation planning, and various techni cal areas (e.g., range, minerals, forestry).

Procedure

Data were collected at three BLM agency meetings and at one special session arranged for the study. At the three BLM agency meetings, participants were randomly assigned to one of the two experimental conditions. At the special data collection session, facility limitations and the small number of BLM staff in attendence made group sub-division unfeasible. In that instance all participants were assigned to the PRE-POST experimental conditic

Each experimental session was directed by one of two male research staff members, who read standardized instructions explaining the rating procedures. Each session followed the sequence previously described for the appropriate experimental treatment. For the curren study photo-slides 1 to 4 were employed, and were shown in serial order. A one-page sketch and verbal description were used to present the landuse impacts to participants in the PRE-POST treatment condition.

Results

To provide reliability estimates pertinen to a range of field conditions where a small number of independent observers carry out the rating task, two reliability estimates have been calculated for each rating scale under each condition. One is the average reliabilit for a single observer, and the other is the average composite reliability for a panel of five observers. The average reliability estimates for single observers consist of the intra-class correlation (Ebel 1951) coefficien derived from a one-way analysis of variance (ANOVA), where scenes are the main effect and the residual variance is the error term. For each rating the composite reliability for a panel of five observers was obtained by an application of the Spearman-Brown correction, which is based upon the single observer reliability and gives a reasonably accurate estimate of composite reliabilities for any number of observers (Guilford 1954).

Reliabilities for the direct ratings of pre- and post-impact versions of the scenes by BLM staff are given in the second two and last two respective columns of numbers in

Table 2. Reliability Coefficients for Contrast and Impact Ratings[a]

Scale	STUDENT PRE-POST (PRE- AND POST-IMPACT)		BLM PRE-POST (PRE- AND POST-IMPACT)	
	r_1	r_5	r_1	r_5
AMBIGUITY	.04	.17	.07	.27
COLOR:				
Overall	.34*	.72	.06	.24
Land-Water Bod.	.49*	.83	.20*	.56
Vegetation	.13*	.43	.05	.21
Structure	.05	.21	.19*	.54
COMPATABILITY	.01	.05	.06	.24
COMPLEXITY	.01	.05	.04	.17
CONGRUITY	.02	.09	.00	.00
FORM:				
Overall	.11*	.38	.04	.17
Land Water Bod.	.18*	.52	.08*	.30
Vegetation	.04	.17	.12*	.41
Structure	.49*	.83	.06	.24
IMPORTANCE	.00	.00	.00	.00
INTACTNESS	.08*	.30	.00	.00
LINE				
Overall	.01	.05	.09*	.33
Land-Water Bod.	.16*	.49	.10*	[illegible]
Vegetation	.41*	.78	.17*	[illegible]
Structure	.25*	.63	.00	.00
NOVELTY	.00	.00	.03	.13
SCENIC BEAUTY	.02	.09	.14*	.45
SEVERITY	.05	.21	.00	.00
TEXTURE:				
Overall	.14*	.45	.08*	.30
Land-Water Bod.	.10*	.36	.04	.17
Vegetation	.00	.00	.03	.13
Structure	.39*	.76	.03	.13
UNITY	.00	.00	.12*	.41
VIVIDNESS	.01	.05	.05	.21
n (Raters)	22		22	

[a] The average single observer reliability is r_1, and the average five observer composite (based upon a Spearman-Brown correction of r_1) is r_5.

*$p < .05$ (probabilities are based upon intraclass correlation and significance is given only for r_1).

STUDY: PART 2

Participants

Participants in this portion of the study consisted of 23 upper division students in the Environmental Planning and Management Program at the University of California, Davis.[9] Participation in the research project was part of a laboratory to a course on visual analysis and planning in which all students were enrolled.

Procedure

Participants were first given an abbreviated three hour version of the standard BLM VCR training procedure by a trained BLM staff member.[10] This training consisted of familiarization with the appropriate sections of the BLM VCRM manual (USDI, BLM 1975), an explanation and discussion of conceptual and practical underpinnings of the VCR system, and the presentation of visual examples with illustrations of VCR use.

One week later students participated in the same PRE-POST experimental condition previously described for BLM staff participants. The procedure was identical except that after completing the direct pre-impact ratings the color photo-slide post-impact version of the scene was presented (rather than the verbal description and sketch presented to the BLM PRE-POST group in the previous study). Because three of the four post-impact scenes were photographic representations of the actual activity, this treatment condition was virtually equivalent to perfect knowledge of the actual visual impacts associated with each landuse activity, subject to the accuracy of the pre-impact simulation.

Results

Reliabilities for direct and contrast-impact ratings are presented under the first two columns in Tables 1 and 2, respectively.[11] A comparison of the BLM and student PRE-POST groups with respect to the PRE-IMPACT direct ratings, the general contrast ratings and the BLM contrast ratings reveals some differences on a scale by scale basis, but in general the level of reliabilities is similar. The

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[9] We would like to thank Dr. Ronald Hodgson, Ms. Sheila Brady and Mr. Ron Thayer of the Environmental Planning and Management Program of the University of California, Davis, for making available the facilities of their institution and for encouraging student participation in this research project.

[10] We would like to thank Mr. Alex Young of BLM's California State Office for conducting the student training session.

[11] One protocol was discarded because of excessive missing data.

Table 1. Reliability Coefficients for Direct Ratings[a]

Scale	STUDENT PRE-POST (PRE-IMPACT)		BLM PRE-POST (PRE-IMPACT)		BLM POST (POST-IMPACT)	
	r_1	r_5	r_1	r_5	r_1	r_5
AMBIGUITY	.02	.09	.09*	.33	.10*	.36
COLOR	.12*	.41	.02	.09	.02	.09
COMPATABILITY	.06	.24	.04	.17	.20*	.56
COMPLEXITY	.68*	.91	.44*	.80	.13*	.43
CONGRUITY	.07	.27	.24*	.61	.02	.09
FORM	.52*	.84	.38*	.75	.10*	.36
INTACTNESS	.20*	.56	.44*	.80	.00	.00
LINE	.34*	.72	.00	.00	.14*	.45
NOVELTY	.60*	.88	.47*	.82	.17*	.51
SCENIC BEAUTY	.10*	.36	.39*	.76	.17*	.51
TEXTURE	.47*	.82	.50*	.83	.14*	.45
UNITY	.00	.00	.26*	.64	.08*	.30
VIVIDNESS	.44*	.80	.56*	.86	.23*	.60
n (Raters)	22		22		33	

[a] The average single observer reliability is r_1, and the average five observer composite (based upon a Spearman-Brown correction of r_1) is r_5.

*$p < .05$ (probabilities are based upon intraclass correlation and significance is given only for r_1).

Table 1.[6] A perusal of these reliability coefficients yields three observations.[7]

First, the general level of the reliabilities is quite low for both the pre-impact and post-impact conditions. The single rater reliabilities for the pre-impact condition range from .00 to .56, with an average[8] of .24 (the possible range for reliability coefficients is .0 to 1.0, with .0 indicating complete lack of agreement and 1.0 indicating complete agreement). For the post-impact condition, single rater reliabilities are even lower, ranging from .00 to .23, with an average of .10. Standards for psychological rating procedures lead to an expectation of reliabilities of .7 or higher.

Second, the average reliability in the post-impact condition was lower than that in the pre-impact condition. That may indicate that the presence of obvious landuse activitie in scenes that were previously in relatively natural states may elicit differential judgments that reduce the reliability of ratings.

Third, five-observer composites do show increased reliabilities for direct ratings to a reasonable degree. However, the average five-observer reliability for pre-impact ratings (.61) is still only moderate in strength, and the average reliability for the post-impac ratings (.36) must be considered low.

A perusal of the reliabilities for contrast and direct impact ratings (importance and severity) indicates an even more problematic state of affairs (see Table 2). The importance and severity ratings for both treatment conditions are in each case .05 or less, indicating virtually no agreement. The state of affairs for general contrast ratings (contrast ratings not including importance, severi and the BLM contrast ratings) or BLM contrast ratings alone improves very little: Average single rater reliabilities for those sets of ratings are .05 and .08 respectively, with predicted five-observer composite averages of .21 and .30 respectively.

Thus, it appears that the rating of the degree of change to be imposed upon the landscape by landuse activities is characterized by very little agreement when the number of raters is relatively small (as is often the case in field settings).

The low level of reliabilities for contrast ratings is particularly distressing since such ratings are frequently used in application To determine whether the reliabilities for both the general contrast and BLM contrast ratings are related to the typical quality of visual impact simulation (i.e., a one-paragraph description plus a one page black and white artist's sketch), another study was conducted using simulation of a notably high quality.

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[6] When more than 10% of the ratings were incomplete, the protocol was considered unusable. Five protocols in the PRE-POST condition were discarded for excessive missing responses. For protocols with less than 10% of the total set of ratings missing, random normal deviates converted to the current scale of measurement using the appropriate distributional parameters were substituted for missing values.

[7] Only general trends are reported in the interpretation of differences between reliability coefficients obtained under the various rating conditions. The usual standard error term for the evaluation of intraclass correlations is not applicable because the number of rated stimuli is not extremely high and all ratings are not completely independent of one another. A statistical procedure is currently under development to permit such comparisons.

[8] Average reliabilities for subsets of rating scales under alternative treatment conditions were obtained by transforming the intra-class correlations into standard, or z-scores, according to the method described by Fisher (1954), averaging the z-scores, and reversing the trans formation.

average single rater reliability of the pre-impact direct ratings is .24 and .22 for the BLM and Student samples respectively, with five-observer composite reliability estimates of .61 and .59 for the same respective groups. The average reliabilities for general contrast ratings are virtually identical in the BLM and Student samples (.05 and .04 respectively for single observer composites, and .21 and .17 respectively for five-observer composite). As with both BLM samples, the importance and severity reliabilities are negligible for the Student sample. The most notable difference between the Student sample and the BLM sample is in the BLM contrast ratings, but even so, the difference is small and the reliabilities remain low. The BLM contrast single rater reliabilities for the Student sample and the BLM PRE-POST sample are .18 and .08 respectively. Those reliabilities corrected for a five-observer composite yield reliabilities of .30 and .52 respectively. Thus, some modest improvement in inter-rater reliabilities is gained through use of visual simulation, but the level still falls below usual standards of measurement.

DISCUSSION

The main purpose of this report has been to describe our on-going research program and the VIA measurement issues it is addressing, Only early selective results are now available. They suggest in general that the reliability of component ratings of observer-based VIA's tend to be low when, as is the case for many current field applications, the numbers of observers and their visual samples of each environment are small. Ratings of visual contrast, or changes imposed by introduced landuse activities tend to be particularly unreliable under these conditions.

However, a cautionary note on interpreting the findings to date is in order. The reliability estimates reported here are based upon ratings of only four scenes. Confidence in obtained reliability coefficients depends upon the degree to which these scenes and their visual impacts characterize the true distribution of landscape scenes and landuses. To the degree that variation is restricted, the possibility of underestimated reliability coefficients is increased. Subsequent reports will present better estimates of reliability based upon a larger sample of scenes (N: 19) and a broader range of impacting activities. The likelihood is that these results will indicate somewhat higher levels of reliability, but whether adequate levels are attained cannot be forecast at this time.

Until the full array of findings from the research project is at hand, recommendations for possible ameliorative changes in the VIA systems under study are somewhat premature. However, possible courses of action include: (1) use of larger panels of observers yielding composite ratings based upon independent judgments by members (Tables 1 and 2, for example, indicate that reliabilities can increase appreciably for larger, in this case five-member, panels); (2) use of marker scenes, reliably scaled along a continuum of scenic quality that embodies variations in activity uses within given landscape types and provides a comparative standard for judging pre- and post-impact conditions for specific cases being considered within the context of field applications; and (3) for contrast ratings especially, more extensive experimentation with the use of various color photographic and related modes of visual simulation. Final reports on the current research program will treat these matters of procedural adjustment and innovation more fully and offer appropriate recommendations.

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Evaluation and Recommendations Concerning the Visual Resource Inventory and Evaluation Systems Used Within the Forest Service and the Bureau of Land Management[1]

Blaise George Grden [2]

Abstract: This paper is an investigation of the Visual Management System (VMS) and the Visual Resource Inventory and Evaluation Process (VRIEP). Questionnaires were developed and sent to persons who were experienced with VMS and/or VRIEP. VMS has been found easier to understand and apply than VRIEP. The methodology of VRIEP has been found to be a more complete approach than that of VMS. Sensitivity levels in both manuals were found to be the sections most difficult to understand, apply, and in need of most improvement and research. Recommended are changes to methodology and criteria as well as the development of a system national in scope with regionally adjustable criteria.

INTRODUCTION

Two methodologies were investigated in this paper;[3] the Visual Management System (VMS) used within the Forest Service and the Visual Resource Inventory and Evaluation Process (VRIEP) used within the Bureau of Land Management (BLM).[4] This study was conducted during 1977.

METHODS AND PROCEDURES

The primary objective of this project was to discover both the merits and problems of VMS and VRIEP and to make recommendations for clarification and improvement of the methodologies. VMS and VRIEP have had wide use in USFS and BLM. The writer contacted persons with knowledge of and experience with either VMS or VRIEP in USFS and BLM, and other professional institutions such as private firms and universities.

Separate questionnaires were developed for VMS and VRIEP. Respondents were asked to rate the methodologies as well as the manual. Questions were organized so that comparative analysis of the sections and the methodologies would be possible. The forms of the questions were of four types: yes, no, and don't know; a 5-point scale of 0-2-4-6-8 with adjectives that corresponded to the numbers, rank order; and open-ended questions.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Landscape Architect, Walla Walla District, Corps of Engineers, Walla Walla, Washington.

[3] Based on Grden, Blaise G. 1978. Evaluation and Recommendations Concerning the Visual Resource Inventory and Evaluation Systems Used Within the United States Forest Service and the Bureau of Land Management. Unpublished MLA thesis, Landscape Architecture and Environmental Planning Department, Utah State University, Logan, Utah.

[4] BLM has since revised VRIEP which is now called Upland Visual Resource Inventory and Evaluation (UVRIE). The author has eliminated any comments or results which no longer apply to VRIEP due to the update.

A SUMMARY OF DIFFERENCES AND SIMILARITIES OF VMS AND VRIEP QUESTIONNAIRE RESULTS

The problems of VMS and VRIEP/UVRIE are many and complex. There are general problems in understanding the methodologies and resistance from persons not experienced in evaluating visual resources. Landscape architects tended to evaluate the systems higher than other professionals. However, all respondents tended to agree on the hierarchy of problems. VMS manual was considered to be biased in terms of mountainous west examples and experiences, while VRIEP (UVRIE) manual was considered to be biased toward Colorado Plateau examples and experiences. Neither was considered to be national in scope.

Nearly all of the VMS questionnaire respondents were landscape architects, while the VRIEP respondents were approximately one-third landscape architects and two-thirds other professionals. VMS respondents applied the system more frequently, but to less acreage than VRIEP respondents. Landscape architects applied VRIEP on an average to larger sites than other professionals. The total average area in which landscape architects applied VRIEP was 3.6 times greater than other professionals (see Table 1).

e 1 - Respondents and their application of VMS and VRIEP.

	VMS	VRIEP	
ondents	60 landscape architect 1 forester	11 landscape architects	18 other professionals
age times applied	5	2.5	2.8
ge hectares (acres) h application	116,000 (286,600)	424,929 (1,050,000)	105,498 (260,700)
l application tares (acres)	591,000 (1,460,700)	1,052,320 (2,625,000)	295,394 (730,000)

Sensitivity Levels

Sensitivity levels in both manuals were found to be the sections most difficult to understand, apply, and in need of most improvement and research.

In prescribing visual resource management classes, this study and research by Burns[5] both found that sensitivity levels were essential.

A higher percent of VRIEP respondents indicated that the sensitivity level section met the objective. The higher rating by VRIEP respondents may be due to the more complex criteria resulting in a more complete approach.

VMS respondents rated the clarity of sensitivity levels higher than VRIEP respondents. This shows the difference of manuals as well as more complex VRIEP sensitivity levels.[6]

VMS respondents had a greater mean range than the VRIEP respondents concerning the ease of application of sensitivity level criteria. This indicates that some of the sensitivity levels of VRIEP are easier to apply and some are harder to apply than VMS criteria.

The respondents indicated that sensitivity level produces more unwanted bias than any other section of the systems, with VRIEP being more biased than VMS. The writer's opinion is that VRIEP criteria are more complicated and the data used in the criteria are difficult to obtain, resulting in more subjective decisions.

Visual-Distance Zones

Research by Burns[5] indicated a concern for the value placed on unseen areas. The respondents to this study agreed and rated unseen area treatment as fair.

According to 75 percent of the respondents, distance-visual zones were valid criteria in determining sensitivity levels. The clarity of the manual in defining and explaining distance-visual zones was rated higher by VMS respondents. This may be due to the fact that VMS manual is more elaborate.

Applying the concepts of visual-distance zones was considered easier by VMS respondents. This may be due to the fact that the VMS respondents applied the system more times and VMS manual was considered clearer.

Scenic Quality

The respondents of VRIEP and VMS questionnaires stated that the scenic quality or variety class section measures variety or diversity. VRIEP respondents rated the "scenery units" higher than the VMS respondents rated character types. This may be because scenery units are easier to understand and to apply.

VMS respondents stated that the variety in the landscape was an accurate factor in measuring scenic quality while the VRIEP respondents stated it was between moderately accurate and accurate. This difference may be due to the fact that VRIEP also includes the factors of intrusions and uniqueness in the rating of scenic quality.

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[5] Burns, Jim. 1976. Summarization of activities, findings, and recommendations of the workshop on sensitivity level determinations for the BLM's visual resource program, Tahoe, Nevada, 16 November. (Mimeographed.)

[6] Sensitivity level criteria in UVRIE have been simplified.

VRIEP landscape architect respondents stated that the concepts used for rating the scenery units were easier to apply and more clearly defined in the manual than VMS respondents rating of the features and classifying them into ABC classes. This could be due to the use of a numerical rating system in VRIEP which is easier to understand and carry out.

Approximately 25 percent more of the VMS respondents than VRIEP respondents stated that the methodology of the scenic quality section produced no unwanted bias. The differences of the scenic quality rating may be due to the complex methodological additions made by VRIEP over the VMS. In other words, VRIEP respondents felt their system was more biased.

Visual Resource Management Classes (Goals)

A greater percent of VMS respondents agreed with the matrix which determines the appropriate visual resource management classes than did VRIEP respondents.

The clarity of the manual in which the management classes was explained was rather higher by VMS respondents than by VRIEP respondents. This may be explained by the quantity of examples contained with VMS manual and the amount of text explaining the classes.

General

VMS and VRIEP respondents rated "applying the system" as the most used and the most helpful method in understanding the systems. The respondents rated reading the manual as the second most used method in understanding the systems. VMS respondents rated reading the manual as the second most helpful method while the VRIEP respondents rated it as the least helpful method.

The comprehensibility, format, and text of the VMS manual were rated higher than the VRIEP manual was rated by VRIEP respondents.

The above differences can be understood by reference to the manuals. VMS manual is more elaborate, with color photographs, illustrations, and examples. VRIEP manual was in "draft" form with fewer illustrations and no photographs.[7]

Approximately 44 percent of the respondents indicated that additional background would be helpful to bring more credibility to the systems.

VMS respondents' professional judgment agreed more with the final results of VMS than VRIEP respondents' professional judgment with the final results of VRIEP. This may be due t the fact that VMS respondents have used the sytem more often over a long period of time and have become used to it.

ISSUES AND RECOMMENDATIONS

Introduction

The following recommendations are based on the results of the questionnaire and current research.

Why two different systems? Now that each has been tested in the field, USFS, BLM and other land management agencies should collaborate and design an integrated system. The systems should contain the same methodology and terminology. The integrated system which is national in scope could be used as a core with allowance for variations, as the system is tested in the different physiographic regions. One national core system would eliminate problems arising when a project crosses more than one agency's land and areas where agencies' boundaries are adjacent. One system would insure equal treatment of the visual resources.

One of the frequent comments of respondent from non-western, mountain regions was that the manual should be more national in scope, concepts, and examples. Each region is compose of different natural features. Different historical events influenced attitudes toward the land and structures such as agricultural fields, buildings, cities, and travel routes. The inhabitants vary in number, character, culture, personality, experience, and economics (Starkey and Robinson 1969, Sonnefeld 1966). The new manual should include an explanation explaining to the user that the criteria must be "fine tuned" for each physiographic region. What is used in the Rocky Mountains cannot be applied in the Gulf Coastal Plain. Some areas of USFS and BLM have adjusted the criteri to fit their needs better, such as in Kootenai National Forest, Arizona, New Mexico, and in the Colorado BLM offices.

The new manual should integrate supplemental references, appendices, bibliographies, and other source materials to help support the methodology. The methodology would then be more helpful to professionals and the general public.

A numerical rating system as in VRIEP/UVRIE would simplify the scenic quality and sensitivity evaluating process and render the system adaptable to computers. The weight of the criteria should be regionally adjustable in range and value. UVRIE manual gives examples of the adaptability of their system for computer use.

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[7] The UVRIEP manual presently used has more illustrations but still lacks photographic examples.

Figure 1 shows the flow diagram for the recommended system.

Scenic Quality

The term scenic quality as used in VRIEP/UVRIE describes the process used to measure the scenic quality of the visual resource. Variety classes used in VMS would be appropriate if scenic quality were based only on the concept of variety. There are additional concepts which might be better used to determine scenic quality which will be discussed later in this section.

Landscape Divisions

One of the initial impressions from reading either VMS or VRIEP/UVRIE manual is that the Great Plains or the Central Lowlands, physiographic provinces of the United States, would be entirely rated "C" class scenery and that need not be true.

Each physiographic province has relative levels of scenery with different visual resource characteristics. Both scale and relationship of objects are also relative in each province.

Scenic quality of the landscape can be determined by dividing the landscape into areas of similar visual resource characteristics and rating each area for scenic quality based on its inherent characteristics. Both VMS and UVRIE incorporate physiographic divisions based on Fenneman (1931, 1938).

Components of the Visual Landscape

Within VMS and VRIEP/UVRIE it is stated that landform, vegetation, and water are basic components of the visual landscape. However, VRIEP/UVRIE also includes manmade components ("cultural features"). Neither VMS or VRIEP/UVRIE take directly into account animal life, an important component in the visual landscape. The components of the visual landscape should include landform, vegetation, water, animal life, and man-made objects and processes. The arrangement of the components of the visual landscape serves to create variety, vividness, and harmony, and will be investigated later in this section.

Design Elements

VMS and VRIEP/UVRIE, as well as some other visual analysis methodologies used the design elements of form, line, color, and texture to describe the components of the visual landscape. The relative importance of each element tends to vary with each physiographic region and subregion, due to atmospheric conditions and available light and other inherent landscape characteristics (Harman et al., 1973; USDA 1972, 1973; USDI 1976).

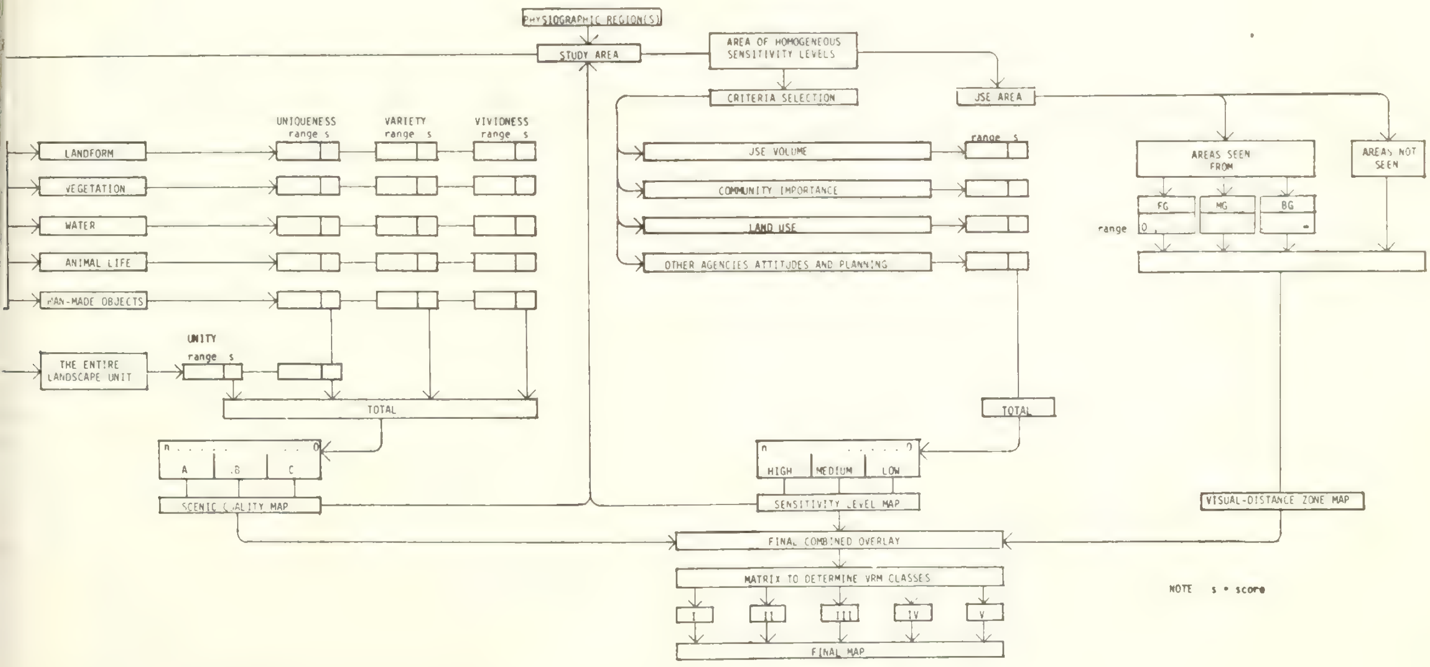

FIGURE 1 - Recommended visual resource inventory and evaluation system flow diagram.

terminology

Variety--includes the number of objects, the distribution, and the relationship in terms of scale between them. Variety is in opposition to monotony where repetition of objects is uninteresting and implies low level scenic quality. Landscapes with the greatest variety or diversity have the potential of possessing higher levels of scenic quality (Sargent 1966; Zube 1971; Litton 1971, 1972; USDA 1973, 1974; Laurie 1975;)[8]

Vividness--is that quality in the visual landscape which is strong enough to make a lasting impression. Lynch (1960) uses the word "imageability," Jones (1975) "vividness or memorability," and Litton (1971, 1972) "vividness." "Contrast is the most obvious source of vividness, if it avoids confusion." (Litton 1972, p. 285).

Unity--is a single harmonious visual unit in terms of the combined quality of the landscape components. The unified landscape is not the arithmetic sum of its components, but the unity of components interacting holistically with each other. (Ocvirk et al. 1968; Handley et al. 1970; Litton 1972; USDA 1972; Jones and Jones 1974, 1975, 1976; Jones 1976; and Laurie 1975).

Uniqueness--is the scarcity of an object or landscape in a physiographic region. The object can be physical, biological, and/or of human interest (Leopold, 1969; Leopold et al. 1971 Leopold, 1966, McHarg 1969; Handley et al., 1970; Leopold, et al., 1971; Jones 1975; Iverson 1975; [8])

Criteria

The methodology of VMS is based upon the criterion of variety as a measurement of scenic quality while the methodology of VRIEP is based upon the criteria of variety, uniqueness, and harmony, which are not explicitly explained. Most respondents stated that variety was an important criterion in assessing scenic quality, which it is, but other criteria exist. Research has shown that variety, vividness, unity or harmony, and uniqueness are factors which assess scenic quality.

The four criteria of variety, vividness, unity, and uniqueness are generally recognized as basic in determining the artistic quality of music, painting, and landscapes. The criteria exist not only as entities but also in interaction (Ocvirk et al. 1968; Litton 1972 Ocvirk and Litton do not mention uniqueness).

Methodology

VMS and VRIEP scenic quality methodologies should be modified to include the recommended criteria. The visual landscape unit can be divided into the components of the landscape: landform, water, vegetation, animal life, and manmade components. These components can be described by the design elements of form, line, color, and texture. The components and the landscape as a whole can be given a numerical rating of scenic quality determined by the criteria of variety, vividness, unity, and uniqueness. The weight and range of the components will depend on two factors: the characteristics of the components and the physiographic region in which they lie. In some regions components such as water or man-made components may be scarce or non-existent. The adjusted weight and range would have to be modified in these instances, however the criteria "uniqueness" would provide a means of compensation.

When rating the components of the visual landscape unit, they should first be rated for variety, vividness, and then uniqueness. Then the visual landscape unit as a whole can be rated for harmony, followed by rating the whole visual landscape unit for uniqueness relative to the defined physiographic region. Scenic quality classes can be determined by the sum of the scores (see table 2).

Sensitivity Levels

Analysis of sensitivity levels is a necessary factor for planners and managers dealing with visual resource management. Sensitivity levels serve to establish priorities as well as prescriptions for change in managing the visual environment. The concept of sensitivity level is not as easily understood or applied as scenic quality or visual-distance zones. This section will need the most research before a methodology is accepted by the majority of professionals.

In VMS, sensitivity levels are the measure of concern that a perceiver has for scenic

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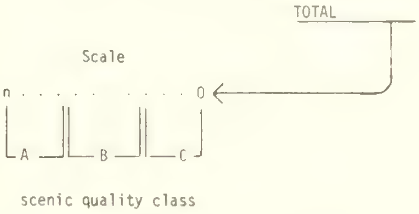
[8] Paulson, Merlyn J. 1975. Western coal strip-mines, related energy conversion structure, and transmission lines: A study of visual quality, visual change, and alleviating visual siting criteria. Unpublished MLA thesis, Landscape Architecture Research Office, Harvard University.

TABLE 2. -- Table to determine recommended scenic quality

measurement criteria	components of the visual landscape	verbal description and value range (varies with region)			score
variety (Y) vividness (V) uniqueness (U)	landform	verbal description & weight			Y V U
	vegetation				Y V U
	water				Y V U
	animal life				Y V U
	man-made objects				Y V U
harmony	the landscape as a whole				
uniqueness	uniqueness of the whole				



quality, while in VRIEP sensitivity levels were ". . . an index of the relative importance or visual value of visual responses to an area in relation to others in the planning unit" and in UVRIE sensitivity levels are indications of user interest and concern for change in the visual resources. (USDI 1976, 6300.05).

Sensitivity levels should serve to measure the concern for the visual resource of persons viewing the area, persons having interest or "stock in the area" but who may never visit the area, and public agencies that have jurisdiction in the area.

Landscape Divisions

While the physiographic regions serve as a basis for division of the landscape into homogenous visual units that can be measured for scenic quality, physiographic regions can also serve as a basis for division of the landscape into homogenous sensitivity units that can be measured for sensitivity levels. There are:

> . . . differences between the people and their cultural traits in each of the physiographic provinces---differences in e ethnology, dialects, educational levels, religions, wealth, industrial or agricultural pursuits and politics. (Hunt, 1974, p. 3)

Along with physiographic regions, regional geography and United States Office of Business Economics (USOBE) have criteria to divide the landscape into regions.

Regional geographers use five major criteria to delineate areas. Man's relationship with the land or geography can be used as a basis to divide the land into regional areas (Starkey 1969).

(1) The land: its extent and quality. (2) The historical events that have been significant in influencing later land use. (3) The accumulation of structures on the land, including fields, buildings, routes, cities, and monuments. (4) The inhabitants of the land: their numbers, character, culture and rates of increase. (5) The income that inhabitants earn and the economic structure within which they earn income.

The mapping procedure of USOBE is based on demography, ethnic, cultural, and social factors of the labor force.

These examples are suggestions, however, the concept might serve to produce a broader basis for determining the criteria used to measure sensitivity levels.

Criteria

New criteria should be developed to evaluate the use area and determine sensitivity levels. The criteria should be based on the defined region and a profile of public attitudes and the consultation of sociologists, economists, recreation specialists, and representatives of other appropriate fields.[9/]).

Use areas, use volume, community importance, land use, and other agencies' attitudes and planning are criteria that can be applied in most regions to determine sensitivity levels of use areas. The criteria have been used in some part either in VMS and/or VRIEP.

The criteria should be adjusted and/or new criteria developed for each region. The criteria weight or value will depend on the particular region. Each use area can then be rated on the established criteria and range, and the appropriate sensitivity level assigned by adding the assigned scores (Table 3).

[9/] Lee, Robert. 1976. Summarization of activities, findings, and recommendations of the workshop on sensitivity level determinations for the BLM's visual resource program, Tahoe, Nevada, 16 November. (Mimeographed.)

terminology

Use Areas -- within a region should be delineated and mapped. Use areas can be places where people live, work, play, and move about. They may include cities, towns, villages, summer home sites, commercial and industrial areas, campgrounds, visitor centers, picnic grounds, water bodies, beaches, roads, and trails. The boundaries of the areas of use are determined by what areas are viewed from the use area.

Use Volume -- is determined by the number of persons in an area or traveling through an area. Perception of the landscape varies with the amount of time it is seen and the speed of movement through it.

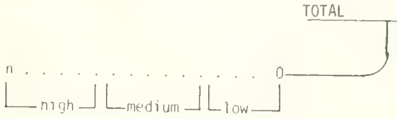
Community Importance -- is the significance placed on a use area by local, state, regional, and/or national communities.

Land Use -- is a general designation or proposed function which occurs above, on, or in the land.

Other Agencies Attitudes and Planning -- and social programs should be taken into account because different agencies represent different attitudes toward management of the visual resources. Lands administered by the National Park Service tend to generate higher values for the visual resources than most other agencies. There may be times when the function a use area may influence the viewshed of a nearby use area.

TABLE 3 .--Table to determine recommended sensitivity levels

	Verbal description and value range (varies with region)			
Criteria	High sensitivity level	Medium sensitivity level	Low sensitivity level	Score
Use volume:	Verbal description & weight			
Community importance:				
Land use:				
Other agencies attitudes and planning:				
Other:				
			TOTAL	



sensitivity levels

Visual-Distance Zones

Since the zones are based on distances of visual perception, it is recommended that the term visual-distance zones be used.

Visual-distance zones determine the viewe areas from use areas, and help to determine the visual sensitivity of the use area as well as the boundaries of the sensitivity area.

An observer can usually recognize that the closer one is to an object the clearer the details of the object are perceived. As distances increase away from the objects, the details become more uniform in color-value and less contrast is apparent between the objects. The other senses such as smell and touch are less acute (USDA 1972, 1973).

Criteria

There are three visual-distance zones used to describe distances in painting, photographs, and the observed landscape--foreground middleground, and background, which are based on the details that can be perceived at a given distance.

Measurable distances such as meters and kilometers can be applied to each visual-distance zones. The measurable distances are used in VMS and VRIEP/UVRIE and are based on research conducted by Litton on national forests in the western United States (Litton 1972).

These distances are arbitrary and do not take into consideration the atmospheric conditions, seasonal or diurnal variations, or variable contextual settings (Litton 1972). These conditions can vary depending on the physiographic region. This results in possibl changes in the length of each distance zone and in the weight given in the matrix to determine the visual resource management classe. The manual should contain explanations of these possible variations.

All three visual-distance zones should be used instead of the two in VRIEP/UVRIE. The foreground is different from the middleground. The background should end at infinity or at a point where the components such as landform or man-made features are not identifiable or visible. The background zone of VRIEP/UVRIE ends at 24.1 kilometers or 15 miles, but a huge structure may be viewed beyond 15 miles. The distances will vary from region to region. More than three zones may be needed in some instances such as the investigation of possible visual impacts.

Visual Resource Management Classes

Through a matrix scenic quality, sensitivity levels and visual-distance zones are brought together to determine visual resource management classes. The three major sections should be regionally adjusted as well as the matrix.

Many of the respondents stated that the terms retention and preservation were misleading and often confusing. This problem could be solved by assigning roman numerals as in VRIEP/UVRIE, instead of terms such as preservation or retention.

The management classes ". . . provide the land manager and supporting staff with objectives for the visual appearance of landscapes that vary with the lands intrinsic scenic quality and its sensitivity to public viewing pressure".[10/]

This is just the first step. The manager and others must know how difficult it may be to achieve the visual management classes in one unit of land as in another unit.

It may appear that it would be easier to meet the least restrictive class than a more restrictive class. But no such correlation is within the system. The opposite can be the case, where it is easier to meet a more restrictive class than a less restrictive class.[10/]

The manual should explain how the visual resource management classes fit into the whole process, and that the classes are not the final decision. The desire for integration of visual absorption capability (VAC) into the VMS was a major comment of the VMS responde respondents. This is now in progress and VAC will be a supplement to the VMS.[11/]

SUMMARY AND CONCLUSIONS

A problem of the methodologies of the management classes is that the higher scenic landscapes tend to receive the higher levels of protection. Protection of common landscapes may be just as important as the high scenic quality landscapes. It can be argued that the protection of common landscapes serves to enhance and heighten the scenic quality of the unique or precious areas.

It should be understood that high scenic quality can exist in unfashionable or inaccessible deserts and plains as well as in popular and accessible areas of craggy peaks, pine trees, and crystal clear lakes. It is only reasonable that each physiographic region be attributed with a full range of potential scenic quality. Since the visual landscape character varies from region to region, the scenic quality landscape features weight and ranges should be adjusted. Public attitudes, and accessibility also vary within regions and over time which is cause for the sensitivity level criteria to be adjusted and tested in each region.

Other problems exist in VMS and VRIEP/UVRIE that are inherent in inventory and analysis methodologies. Random as well as systematic errors occur in application of methodology. By educating the users to the complexity of the systems, these errors can eventually be controlled.[12/]

Improvements in the methodologies should be made as more research is available. The existing areas that the systems have been applied to should be periodically updated for continuing relevant management decisions. Public attitudes may critically affect the existing data in a relatively short time. The methodologies should be kept as simple as possible without sacrificing a complete approach.

We can ask, "Should the systems have been invented?" Because of the size and extent of USFS and BLM, a manual on visual resource management is necessary. Visual resource analysis provides the land manager with an understanding by sharpening one's sense of awareness and thus encouraging better decision in planning and management.

The systems do provide an integrative basis for collaborating land managers to act in concert while also enhancing accountability to the public. VMS and VRIEP should be considered a positive pioneering step in managing the visual resource.

In the future, public agencies can become more systematic and sensitive to the importance of visual resource and the effects of the visual resource policies and management on the feelings and actions of the public.

A committee, agency, or institution needs to coordinate a national visual management system, research, and information at all levels of government if we are going to manage our landscape's visual resource.

[10/] Iverson, Wayne D. 1975. Visual absorption capability. (rough draft). United States Department of Agriculture, Forest Service, California Region, San Francisco. (Mimeographed.)

[11/] Iverson, Wayne D. 1977. Letter to Blaise Grden. San Francisco, California, 21 March.

[12/] Becker, Carlisle. 1977. Assistant Professor of Landscape Architecture, Utah State University, Logan, Utah. Personal interview, October.

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The Generation of Criteria for Selecting Analytical Tools for Landscape Management[1]

By Marilyn Duffey-Armstrong[2]

Abstract: This paper presents an approach to generating criteria for selecting the analytical tools used to assess visual resources for various landscape management tasks. The approach begins by first establishing the overall parameters for the visual assessment task, and follows by defining the primary requirements of the various sets of analytical tools to be used. Finally, the paper reviews and critiques a number of existing techniques available for assessing visual (aesthetic) resources by applying the criteria developed.

"There are almost always trade-offs to be made to suboptimize all objectives."[3]

INTRODUCTION

A statement of objectives implies that an understanding of how well a system should work, and for what purpose, is clearly understood. Since every action and every policy has, or should have, a statement of objectives, those involving landscape management are no exception. The difficulty arises when the objectives of one set of policies and practices within one institutional system must meld with those of others.

During the past decade we have seen a growing concern for environmental quality manifest itself in a multitude of legislated standards and public agency guidelines directed to protecting the environment. The next decade is likely to evidence a similar trend focused on resource development and energy conservation.[4] Melding the issues surrounding these two separate, but related, national concerns will not be an easy task, particularly for agencies caught up in trying to manage the resources germane to both areas of concern.

The need to locate and develop new energy resources in the United States promises to place ever-growing pressures on landscape managers to compromise visual resources. For example--the siting of a 200-foot wind generating turbine, or acres of solar collectors, or nuclear power plants with their cooling towers and plumes, or even the dedication of vast amounts of land for silvaculture to feed a biomass facility--all represent problems for visual resource management.

The immediacy of the energy situation in the United States has created an atmosphere of urgency in planning decisions. Proposals for development have been initiated in many geographical areas of the country. Professionals in the area of landscape management must interact with the decision process *now* in a systematic way, or we will not have the wide range of visual resources to manage in the future that we have available today.

Since visual resources in a narrow sense and aesthetic resources in the broader sense are inherently a part of both environmental quality and resource development, it is essential that public agencies attempting to manage these resources have tools available that will allow them to make an objective assessment of the trade-offs between development (and preservation) options and still include the various interests of the stakeholders associated with each area of concern. The tools are available, though some may need refinement. The key to a successful assessment lies in the selection of the appropriate tools for the management task, and not in how elaborate the individual technique might be.

This paper presents an approach to generating the criteria used for selecting the analytical tools for a variety of landscape management tasks, including:

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Senior Analyst, SRI International (formerly Stanford Research Institute, Menlo Park, California; and private consultant.

[3] U.S. Forest Service, Landscape Management Handbook #483.

[4] These trends are, in part, directly tied to the passage of the National Environmental Policy (1969) and the National Energy Act (1978).

- Environmental impact assessments of alternative energy developments.
- Scenic and open-space preservation.
- Development of land-use plans and overall master plans.
- Plans for special activities, such as recreation development, roadway development, utility corridors, and so on.

The approach to criteria generation focuses on defining the primary requirements of the various sets of analytical tools used for visual assessment, and on matching these with the overall objectives, stakeholders, and ultimate decision makers using the information generated.

The paper will, first, identify and discuss the basic categories of criteria which apply to most landscape management decisions, and then will discuss how individual criteria within each category might differ depending on the task at hand. The paper concludes with a brief review of a number of visual assessment tools, and discusses how each satisfies the different sets of criteria within both resource development and environmental protection issue areas.

CRITERIA GENERATION

Criteria are a set of standards that can be used to evaluate how well various options satisfy an overall objective. The generation of criteria usually accomplishes two purposes: first, it encourages the user, or decision maker, to articulate the important factors in the task; and second, it provides a mechanism for making an objective assessment of the options. It is particularly useful if each criterion, within a set of criteria, can be ranked according to degree of importance to the user and the stakeholders, thus allowing priorities to be established early in the assessment process.

The need for a visual assessment is sometimes an independent task (e.g., the visual quality inventory of land owned by a single agency), but more often is part of a much larger task (e.g., the environmental impacts of a proposed geothermal power plant or a new roadway); thus, the criteria used for the visual assessment must reflect the overall scope and objective of the entire study task. If the visual assessment task is a part of a larger assessment study, the criteria should be compatable with that used for the overall study. For example, the indirect or induced impacts, such as economic impacts, number of persons or activities affected, effect on growth or development, and finally, the degree of resistance to the proposed activity (or project) should be accounted for so that those impacts directly and indirectly associated with visual impacts might be evaluated along with those associated with the technical aspects of the project. This is not to say that visual assessments must be quantitative rather than qualitative, but they must at least address similar categories of concern in order to become a part of the overall evaluation scheme. All too often, the visual assessment component of a study is given a "footnote status" simply because it does not directly relate to the factors discussed under the more technical categories of assessment. And yet, the visual assessment factors are typically the ones underlying the ultimate reasons for support or opposition to the proposed action.

The approach to criteria generation follows a logical progression of steps (Figure 1) beginning with a definition and understanding of the landscape management task. Landscape management tasks can range from the development of policies for the preservation of visual resources, for example, to the actual design phase of a new development, such as the siting of a utility transmission line. Once the objective for the overall study task is defined, a statement of the role that the visual, or

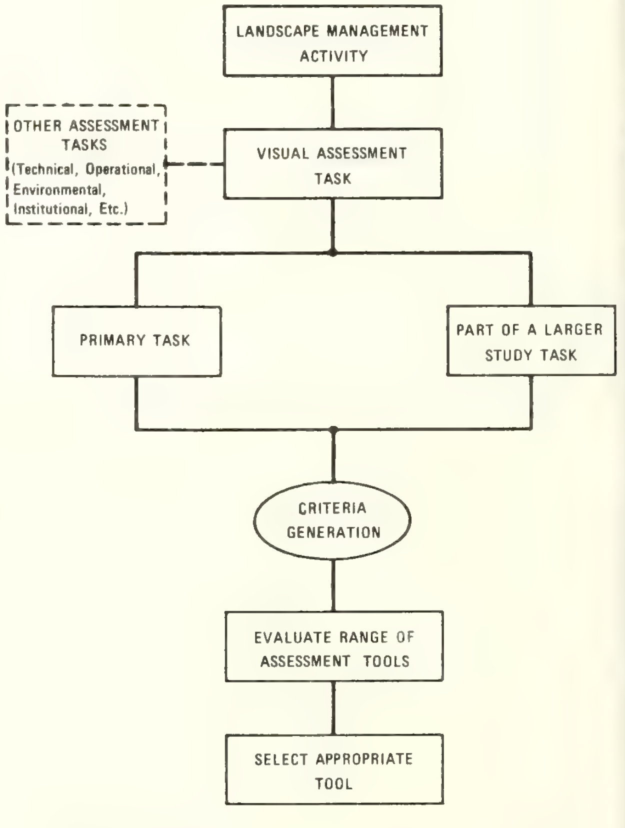
LANDSCAPE MANAGEMENT ACTIVITY
OTHER ASSESSMENT TASKS (Technical, Operational, Environmental, Institutional, Etc.)
VISUAL ASSESSMENT TASK
PRIMARY TASK
PART OF A LARGER STUDY TASK
CRITERIA GENERATION
EVALUATE RANGE OF ASSESSMENT TOOLS
SELECT APPROPRIATE TOOL

Figure 1--Approach to Criteria Generation aesthetic, assessment task plays should be prepared. For example, the development of a policy to "preserve the unique bodies of water on public lands" would require a visual assessment task to inventory all bodies of water and then assign a visual resource quality rating to each. In this example, the visual assessment task would be the primary task in the study and would therefore have criteria specific to its own statement of objectives.

If, for example, the visual assessment task is only a part of a larger study task, such as the environmental impact assessment of a geothermal development, the objectives and criteria for the visual task must reflect the overall study objectives (such as to select options that minimize disruption to the natural setting while still maximizing the efficiency of the geothermal resource).

Typical categories of criteria used for evaluation schemes in overall study tasks include the following:

- Long-term versus short-term tradeoffs.
- Assessment of the irreversible commitment of resources.
- Impacts to the human environment such as economic, social and institutional impacts--the number and categories of stakeholders affected.
- Impacts to the natural environment.
- The technical difficulty and the costs involved with implementing the proposed action.
- Openness to public input.

Criteria within each of the above categories tend to vary somewhat depending on the scope of the management task being addressed. For example, in the siting of a utility substation and transmission lines, the criteria in the last four categories would be most important because the primary concern is to minimize the direct impacts of the new development. If, on the other hand, the project is a geothermal development, the emphasis would be on the first two categories of criteria because the visual impacts of the development induced by the availability of geothermal power (presuming it will be lower cost than conventional sources such as oil) would be far greater than those of the actual physical plant. Similarly, master plan development and policy development that influences growth and the form of development in future years would emphasize criteria within the first two categories. (A move to dispersed rather than central energy systems such as solar heating and cooling is an example of a policy in this category.)

In order to illustrate further the importance of criteria generation for visual resource management, a recent policy evaluation process on the Island of Hawaii is described. The policy under consideration was a statement by both the state and county governments for a move to energy self-sufficiency by the year 1990.[5] The assessment process had to do with identifying all renewable energy options available on the island and making an assessment of the economic, social, and environmental impacts of each of the options.[6] The visual assessment part of the task was clearly directed to identifying and assessing the magnitude of the impacts directly resulting from the development of the physical facilities associated with each energy option.

Using the approach outlined in Figure 1 of this paper, it became evident that the visual assessment task must also address the longer-term impacts induced by each of these options (or combinations of options) in order to be consistent with the criteria of the broader study task. The differences had to do with looking at the change to the visual and aesthetic character of the island that could occur given an inexpensive energy source (such development as manganese nodule processing plants to extract aluminum from ores from the sea, extensive hotel and tourism growth, general population influx, and so on). The result was that in addition to the straightforward assessment of the visual impacts of each of the energy options, a more complete assessment would allow for an assessment of the tradeoffs with conservation options, stronger regulatory and environmental controls, and the longer-term development objectives for the island. For example, one of the energy options was further use of the existing biomass facility (located in conjunction with the sugar cane processing plant). This facility produces low-cost energy by burning the waste product from the sugar cane processing, thus eliminating a waste disposal problem. The same operation, however, also generates visual impacts from excess emissions (particulates) and effluents (sedimentation in discharge to the ocean). The cost of controlling these impacts is over $1.5 million per year in environmental control technology. A continued expense of this magnitude will eventually run the plant out of business and thus eliminate one of the most efficient renewable energy sources on the island. The tradeoffs between the visual impacts resulting from this biomass activity

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[5] Self-sufficiency in this case meant a reduction in the amount of imported oil to the island.

[6] Options included wind energy machines, hydropower from waterfalls, biomass conversion using sugar cane residue, geothermal development in the volcanic region, and solar hot water.

(which are ultimately controllable and focused on one location) and those resulting from massive industrial and commercial development, such as that which would accompany geothermal and ocean thermal, turned out to be of primary interest to decision makers and the general public in Hawaii. This assessment would not have happened without the careful review of criteria for the overall study task and a structuring of the visual assessment task which looked beyond the immediate, more obvious impacts.

Once criteria have been defined for the visual assessment task, the user is ready to consider how various analytical tools might help provide the information needed. Visual assessment tools include:

- Manual graphic techniques--such as artist renderings of the landscape.
- Photographic techniques--sometimes with photo retouch images superimposed in the scene, and photomontages.
- Descriptive techniques--such as matrices and checklists.
- Mapping techniques--such as overlays and color coded maps.
- Computer graphic simulations--in some cases combined with photographs.

Each of these techniques is described in detail in the accompanying papers in this publication. The remaining section of this paper is a brief review of each categorical area and a discussion of how well techniques within each category satisfy the various sets of criteria described above. Examples of specific techniques are identified for each categorical area; however, for a more complete selection of analytical tools the reader should refer to a report by the author entitled "Aesthetics in Environmental Planning" (Bagley, 1973) and "Measuring Scenic Beauty: A Selected Annotated Bibliography," The USDA Forest Service (1976).

REVIEW OF VISUAL ASSESSMENT TOOLS

Visual assessment tools are designed both to provide an illustrative description of the existing characteristics of the landscape and to enable a user to simulate the changes to the landscape that would result from a planned development or management activity. The information generated by these tools is merely input to the ultimate assessment tasks. The success of the tasks lies in the creative and systematic application of the tools to the overall problem.

A few general criteria apply to all categories of visual assessment techniques; these include:

(1) The technique should provide information generated from public experience, as free as possible of the developer's biases. The method should be as objective as possible and should at least reflect knowled of information generated from studi developed for assessing user preferences.

(2) The technique should cover the full range of attributes in the environment including natural and man-made (built) characteristics, unique features, and misfits (intrusions whic detract from the setting).

(3) The factors and variables used shou be appropriate to the scale and purpose of the ranking system. Thus, ranking system designed to evaluate a large region for the purpose of formulating a land-use policy may necessitate an entirely different set of factors and variables than a system prepared to evaluate a campi site.

(4) A good technique will be straightforward and easily reproduced by others (planners), and relatively inexpensive to employ. Persons having skills and training similar to those who develop a technique should be able to reproduce and evaluate it Likewise, the complexity of the technique and sophistication of the tool used in the system should reflect th resources typically available to the intended users (including manpower, budget and hardware resources).

(5) The output from the technique (information generated) should be easily translated and useful as a communicative tool between planner and decision maker; and between decision maker and the relevant public.

(6) Values assigned to visual impacts or simulated changes should indicate especially sensitive aspects that influenced evaluation (special interest groups, trends in established values, culturally diverse groups).

Manual Graphic Techniques

Hand-rendered plans, perspective sketches, ections and elevations have a long history as seful tools for design analysis of changes nd for public presentation. These artist enderings offer particular advantages in that hey present a visual image based solely on uman perception. A skilled artist can thus portray the important characteristics in a manner that helps generate particular responses in the observer. Depending on the number and complexity of images desired, and with limited data available, this technique remains among the lowest-cost presentation tools.

The disadvantages of the manual graphic techniques are that: the accuracy of the image is dependent on the artist's perception and interpretation of the scene, thus making objectivity difficult; high-quality drawings are time-consuming to produce and difficult to change once completed; and, finally, some persons have difficulty understanding the image presented by line drawings, such as sections and elevations.[7/]

Photographic Techniques

Photographic techniques include: a straight snapshot of a particular view of a landscape, or portions of the landscape; a photo retouch with a proposed change to the scene air brushed or spliced in; or a photograph with an artist's sketch or computer graphics printout superimposed on the scene. Photographs offer the advantage of allowing realistic reproductions of the existing image. They are usually cost-effective, given that a skilled photographer and photographic equipment are available, and they provide familiar presentation images to the general public and decision maker (unlike trying to "read" line drawings).

The disadvantages of this technique are: it is sometimes difficult to highlight characteristics of particular significance for soliciting response from the public, and it requires extra time to superimpose changes to the existing landscape scene.

Additional limitations include the difficulty of covering a large expanse of space (without the use of costly aerial photographs) or hard-to-get-at perspectives, thus making large-scale evaluation schemes difficult. Examples of photographic techniques are described in studies completed by Shafer and Mitz (1970); Burke et al. (1968); and by Jones and Jones et al (1975).

Descriptive Techniques

Visual assessment tools under this category include: inventory-type checklists of characteristic attributes in the landscape (e.g., a grove of redwoods, a pond, a flowering tree, a mountainous horizon, and so on); matrix checklists attributing an evaluation factor to each attribute; and narrative description of relevant landscape characteristics. Examples of techniques which fall within this category have been developed by Handley (1973); Leopold (1969); and Litton (1972).

Descriptive techniques lend themselves to environmental impact assessment projects because they produce information compatible with the format of other environmental characteristics (e.g., air quality, water resources, vegetation, social and economic characteristics, etc.); however, without the use of other visual presentation tools (maps, photos, drawings) they can have limited impact on decision makers because it is extremely difficult to articulate physical changes to the landscape effectively without the use of a graphical image of some type. It is also very difficult to treat detail adequately without extensive text, or an extremely talented writer.

Mapping Techniques

This approach can include combinations of aerial photographs or geological survey maps with manually prepared overlays describing landscape characteristics. Two examples of this technique include: the one described in Design with Nature by Ian McHarg (1969), and "How to Rate and Rank Landscapes," by Hart and Graham (1967).

This approach offers the opportunity for a comprehensive analysis of visual resources as they are related to other environmental factors (landform, vegetation, ecosystems stability, and so on). Additionally, because it combines graphic illustrations (maps) it is visually informative as well. The major disadvantage is that the data collection necessary to develop this technique is labor-intensive and thus time-consuming and costly.

Computer Graphics

During the past several years a number of public agencies, universities and private firms have developed computer-generated graphic assessment tools. Once the descriptive information is input to the computer (detailed data

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[7/] "Creating Land for Tomorrow," Landscape Architecture Technical Information Series, Volume 1, Forest Service, 1978, p. 38.

describing height of terrain, height and density of surface patterns coded in grid cell structures) the computer can output a three-dimensional line drawing on plotted paper or 35 mm film. It is possible to produce computer-generated plans, perspective sketches, and profiles of existing and proposed landforms and surface patterns. Once the extensive input data task is complete, the computer can generate views of a project from many different heights and locations in a very short period of time.

Disadvantages are similar to those mentioned above under mapping techniques--extensive data collection which can be time consuming and costly (plus the cost of computer time), in addition to the problem that software is difficult to analyze for built-in assumptions and not always easily reproducible by a lay person. Further, unless combined with photos, the graphic printout may be unfamiliar to the public and thus difficult to understand.

Examples of computer-aided visual assessment techniques include those described in reports by Bunde (1972); Feeser (1971); and Fabos (1974).

In summary, each of the analytical tools described above has specific advantages and limitations, which further illustrates the point that it is the selection process that is critical to the assessment. In some cases a combination of these tools provide a more complete understanding of the situation than the use of any one tool alone.

The usefulness of the visual assessment tools does not lie in the fact that they may be the latest creation available, or the most glamorous portfolio of illustrations to show the decision makers, but rather, how well they satisfy the need for information that feeds into addressing the overall objective of the assessment project. The assessment tools, properly used, offer an opportunity to do a more objective and systematic job of including the visual tradeoffs with other impact areas in the overall landscape management task. The critical step in the evaluation process is the generation of the criteria for the task itself, thus enabling the selection of the appropriate tools. If we, as professionals, expect to influence the visual quality of our future landscape, we must move beyond focusing on the tools and reassess our understanding of their application and usefulness in the decision process.

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Appropriate Combinations of Technology for Solving Landscape Management Problems— Session E: Surface Mining and Reclamation

Texas Lignite and the Visual Resource: An Objective Approach to Visual Resource Evaluation and Management[1]

Harlow C. Landphair[2]

Abstract: This paper relates the evolution of an empirical model used to predict public response to scenic quality objectively. The text relates the methods used to develop the visual quality index model, explains the terms used in the equation and briefly illustrates how the model is applied and how it is tested. While the technical application of the model relies heavily on existing computer technology and remote sensing techniques for assembling and manipulating the data, the primary value of the work lies in what was learned about using photo response tests and surveys as measures of predicting public response, and how this relates to managing the visual resource.

PREFACE

Since 1930, nearly 100 percent of the electrical energy produced in the state of Texas was from steam generators fired by natural gas. However, with the rapid escalation of fuel prices since the 1960's, there has been an almost unbelievable shift in emphasis from natural gas to lignite (low grade coal) as the primary energy source.

In 1979, there was only one major lignite producing surface mine in the state, the Sandow Mine at Rockdale, Texas. This mine produced coal to generate power for the Alcoa Aluminium Plant located there. Between 1970 and 1976, two new mines were opened and by 1980, there will be a total of eight or nine major lignite producing operations in the state. In less then 10 years, mine production will grow from 10 million short tons per year to more than 40 million short tons per year; an increase of 4 times the 1976 rate. And, all of the coal will be recovered by surface mining.

On an average, each 1 million tons of coal mined will disturb 125 surface acres, therefore an annual production of 40 million tons will disturb 5,000 acres a year. Based on the estimated coal reserves there are potentially 1 million acres that will be disturbed by surface mining for lignite alone.

Even by Texas standards 1 million acres are a sizable chunk of real estate but what makes this particular chunk even more important is the fact that all of the coal bearing deposits lie within 100 miles of the state's major urban centers (Figure 1).

The proximity of these reserves to the major urban centers has increased the desirability of development of lignite as an energy resource. At the same time the location also increases the potential for generating adverse public reaction to the mining activities because there will be frequent visual contact with the mines. Recognizing this, and the documented success and value of Visual Resource Management (VRM) projects in other parts of the country, the Center for Energy and Mineral Resources at Texas A&M University initiated a VRM study of the Texas Lignite Belt to find out

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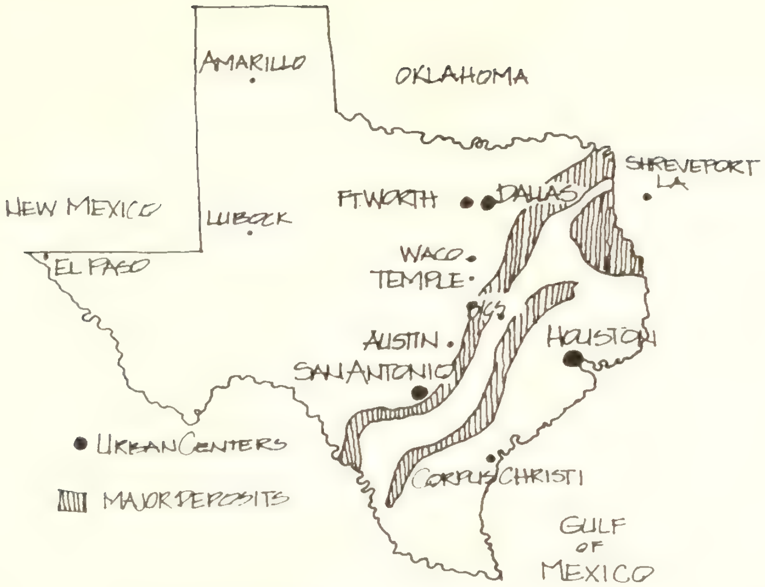


Figure 1. Location of Major Lignite Deposits in Texas

what problems might exist and how they can be managed.

When the study was initiated in January 1978, it was the intent to utilize the visual resource evaluation techniques developed by Leopold (1968, 1969) Litton (1967, 1968, 1971, 1973, 1974) and others (see Literature Cited). This effort included the basic photograph evaluation surveys and field surveys of the central portion of the lignite belt. These early efforts did not yield high results that showed any consistency. The major concern was the large discrepancy between the way people valued photographs of representative landscapes and how the group responded to these same landscapes when experienced in the field.

The reasons for the inconsistencies in the early work cannot be positively stated at this point, but it appears to be a function of two major parameters; the wide variation in vegetation and subtleness of the landscape, and the geographic influence on the public's opinion of scenic quality. The topography of the lignite bearing region is predominately rolling but the vegetation changes radically from pine forest in the east to near desert in the west. Associated with the change in vegetation system there appears to be a corresponding change in the public's opinion of what scenic quality is.

The geographic relationship to public opinion of scenic quality would seem to have caused the variety of response obtained in the early photographic survey and attempts to validate them in the field.

Faced with these inconsistencies and realizing that a substantial data volume was going to be required to achieve any valid results, the entire project was reorganized and redirected. First, the data base was coded for computer storage and manipulated to handle the volume. Then it was decided that the public opinion sample would be restructured to a mail survey format that would allow larger samples and closer control of geographic differences.

While most of the techniques and methodology explained in the study were developed by independent evaluation and empirical field observation, the process that has evolved parallels the "Scenic Beauty Estimation" method developed by Terry Daniel and R. S. Boster (1976) at the University of Arizona. Review of their work and the similarities between the systems tends to support the thesis that scenic beauty can be objectively measured using common resource data frequently used for other types of resource planning.

The primary objective of this paper is to present the hypothesis of the "Visual Quality Index" (VQI) model. The paper explains how the model evolved and discusses how it is being applied in Texas. It should be kept in mind that we are still in the process of completing the project and it is reasonable to expect that changes and refinements will take place as the work progresses.

VISUAL RESOURCE EVALUATION MODEL

Introduction

The concept of Visual Resource Management has quickly taken its place among the contemporary buzz-words of the profession, along with Environmental Planning, Natural Resource Analysis and all the other analyses. In most quarters the concept has achieved wide acceptance as a valid land management concern, NEPA aside. But it should not be forgotten that VRM is still a concept, an idea, not a science. Most of us interested in the visual environment and its management realize this all too well when it comes time to justify our conclusions and recommendations to the ultimate client. However, thanks to pioneers in the field like; Litton (1967,1968,1971,1973,1974), Leopold (1968), Lewis (1964), Jones (1975), Hamill (1971), Boster and Daniel (1976) and others, we at least have some benchmarks to draw on.

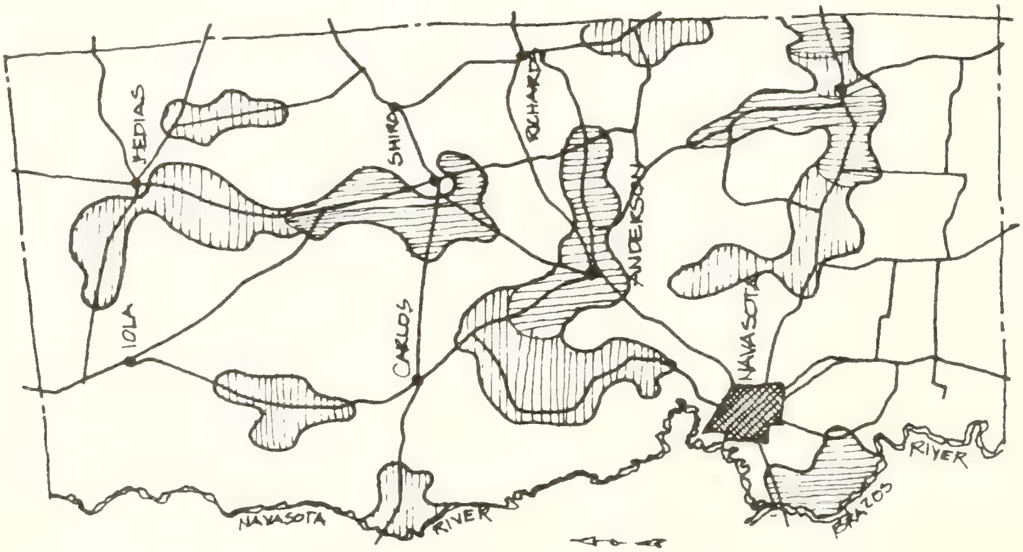
This point is emphasized since the ideas presented in this study are drawn freely from the work of the authors cited. There is nothing in the paper that can be claimed as being earthshakingly new. It is however, an attempt to model the visual resource in a more objective way so that subjective judgement plays a limited part in the process.

Visual Quality Index

Evolution of the Concept

The concept of the Visual Quality Index system grew out of an interest in objective ranking systems and the need to be able to pr dict with some degree of certainty visually sensitive landscapes using readily available data. In reviewing the work of the authors c earlier and studies similar to this project i was noted that, for the most part, evaluation criteria were developed by the professional t involved in the study and applied with accept results. Specific examples of similar studie are the Mineral King Visual Analysis, Johnson (1974) and Smith River Highway Visual Analysi U. S. Forest Service (1973).

In order to get a feeling for how a simil process would work it was decided to go throu a full cycle in an adjacent county and test o findings by field visits and by public opinio survey. The preliminary studies were accomplished in March of 1978, based on criteria similar to those set down by Leopold (1971) a Litton (1967). The map in Figure 2 indicates those areas identified by the team as having high scenic value and most sensitive to chang



THE SCENIC AREAS OF GRIMES COUNTY, TX.
TEAM SURVEY, FEB. 1978

Figure 2.

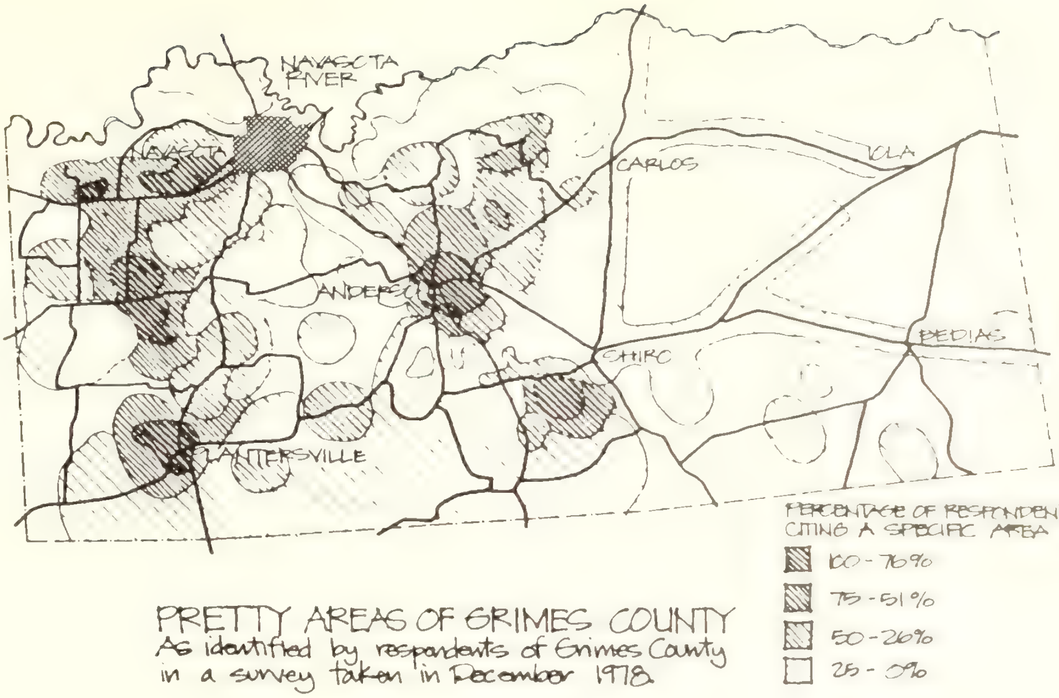

NAVASOTA RIVER
NAVASOTA
CARLOS
IOLA
ANDERSON
SHIRO
BEDIAS
PLANTERSVILLE
PERCENTAGE OF RESPONDENTS CITING A SPECIFIC AREA
100-76%
75-51%
50-26%
25-0%
PRETTY AREAS OF GRIMES COUNTY
As identified by respondents of Grimes County in a survey taken in December 1978.

Figure 3.

In addition to the team evaluation a series of random photos were taken along the major roads in the county and ranked by 60 college students (30 political science majors, 18 horticulture students and 12 landscape architecture students) and 10 Grimes County residents. The results of this survey have variation but tended to support the professional team judgement. To check the results further we took the student group to the field and asked them to rank the scenic areas on a map while driving along the same route used to take the photographs. This test yielded radically different results with very little correlation between the photo survey and the field survey.

This put the early work on a very shaky ground so a mail survey was initiated to find out what the county residents thought were the prettiest and ugliest parts of the county. Figures 3 and 4 are maps of pretty and ugly areas identified by the residents of Grimes County in the mail survey. The population sample totaled 500 (10 percent of the population) selected by random number from telephone subscribers in the county. There were 50 valid questionnaires returned representing a 1 percent actual sample. At first this sample seemed too low until the results were compiled and compared regarding place of residence, age, etc. When this was done, the correlation of response was so close that the results could be considered statistically valid.

Examination of the two maps quickly shows that there is considerable variation in the public's opinion of what is scenic and that of the now humble study team. A quick comparison of the overall results indicates that the study team had anti-culture, anti-urban, pro-topography, pro-pine forest biases. This early failure to predict scenic quality successfully was enough to generate a burning desire in the study team to find a more objective methodology to predict scenic quality. To this end a serious field study was initiated of the scenic areas identified in the survey.

Some of the general points noted were that scenic sites related strongly to corridors as Lewis (1964) stated and that evidence of culture; e.g., fences, barns, improved pasture, tended to enhance public awareness. Other patterns such as vegetation type, topography, depth of field and viewer station did seem to play a part but not with the consistency one might predict. With further study and follow up interviews, several major points of significance became more apparent:

- The general public does have an opinion of what is scenic and what is not scenic.
- The public's opinion of what is scenic or ugly is relatively consistent within the geographic area if they have been in residence for a reasonable period (1 or more years).

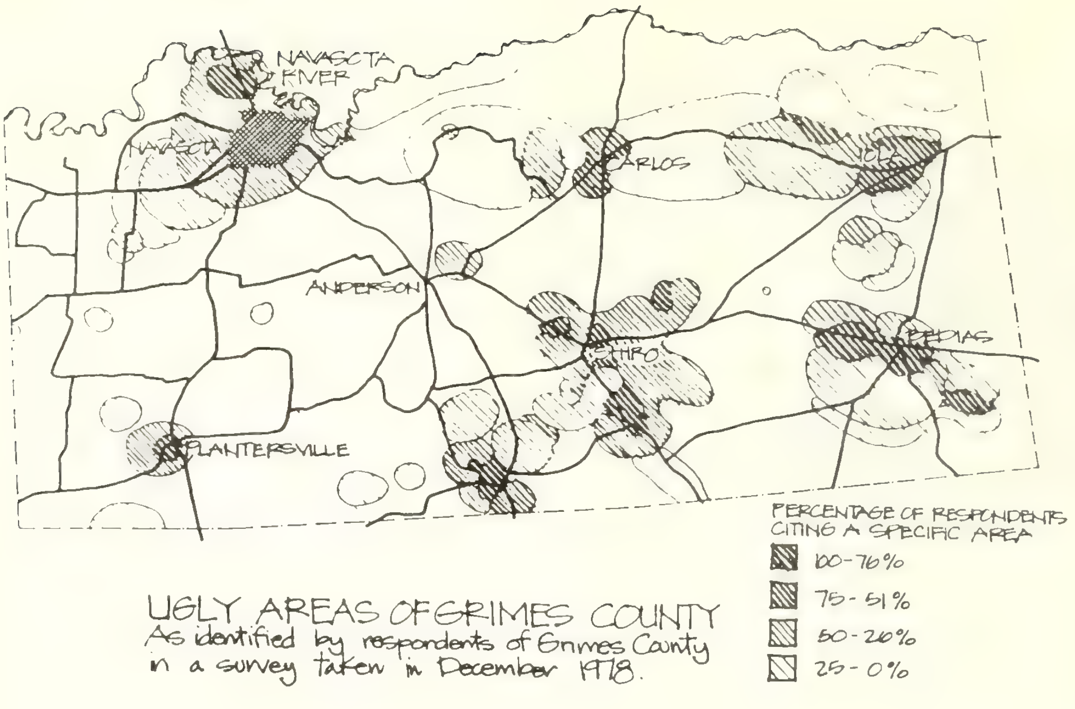

NAVASOTA RIVER
NAVASOTA
CARLOS
IOLA
ANDERSON
SHIRO
BEDIAS
PLANTERSVILLE
PERCENTAGE OF RESPONDENTS CITING A SPECIFIC AREA
100-76%
75-51%
50-26%
25-0%
UGLY AREAS OF GRIMES COUNTY
As identified by respondents of Grimes County in a survey taken in December 1978.

Figure 4.

- Scenic occurrences are related to highway corridors and the frequency of citation increased adjacent to urban centers. This tended to correspond with commuting routes, i.e., frequent observation.
- Comparison of areas with similar physical qualities not cited as scenic and those identified as scenic revealed that these areas were obscured from the corridors limiting the duration of observation.
- A study of the areas considered scenic indicated that as the diversity of elements visible increased the area was cited more frequently, e.g., the photo in Figure 5 was among the most cited. It shows evidence of culture, forest, savannah, pasture, crop land, very simple foreground (uncultured) with the major complexity occurring in the middle ground. Figure 6 is a site rated equally high and has a similar composition with respect to foreground, middle ground and background, yet it does not have the diversity of components.
- The comparison above suggests that a diversity to homogenity scale, as some have indicated, will not be a valid measure by itself. Further comparison of areas cited as scenic suggest that a second variable is at work that we have called order. It seems at this point that people are inclined to accept a landscape as scenic so long as everything is in its place.

Finally, there seems to be a definite preference in Grimes County for landscapes that provide a broad open vista or at least depth of field. Areas where the vegetation forms a narrow corridor along the highway were infrequently cited as having scenic value. In this case there also seems to be a definite lack of preference for pine forest which is a somewhat anomolus condition in this region. It is also interesting to note that the change from pine forest to hardwood forest is not a gradual tra sition, as one might expect, it is abrupt. Figures 7 and 8 were taken on Highway 30 exact half a mile apart. The fact that pine forest was not cited as scenic tends to support the idea that people do not recognize anomolus vegetation as scenic. Yet when it was present in the photo survey, Figure 7 was ranked consis ently high.

Many of these points correspond to observations in other studies but they have not bee used jointly and tested to see if they can in fact be objectively quantified. For this reas it was decided to approach the questions as a simple weighted linear model and test the hypothesis by similar surveys to the one conducted in Grimes County.

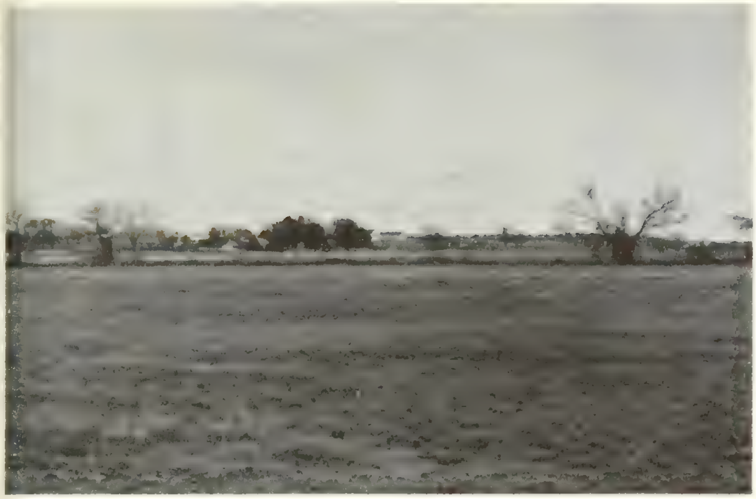
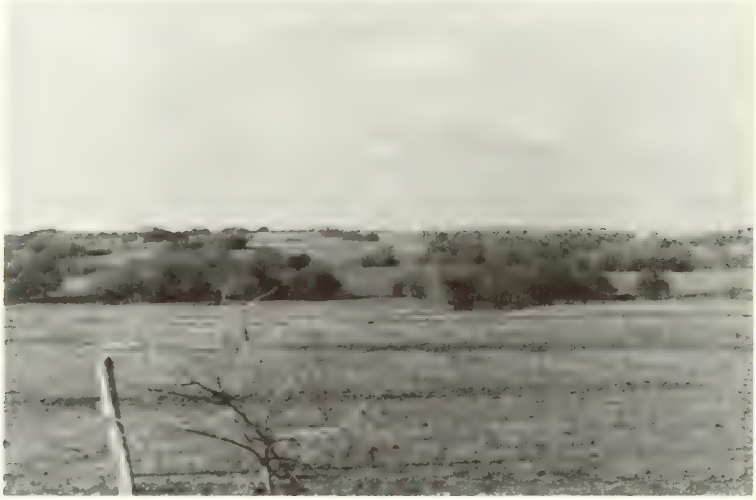


Figure 5.

Figure 6.



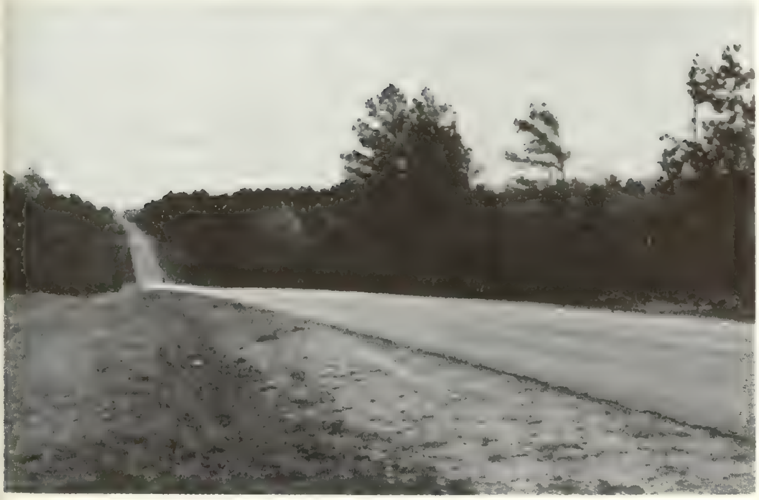


Figure 7.

Figure 8.

The Model Hypothesis

From the observations made in the review of Grimes County survey, four primary variables were identified: frequency of visibility, duration of visibility, diversity of landscape elements and landscape order. The relationship between these variables is hypothesized to be $I = \frac{d}{o} \cdot f \cdot t$.

Frequency and duration of visibility are hypothesized to have a proportional relationship. That is, as both frequency of visibility and duration of visibility of any given landscape increased the greater the chance of the landscape being considered scenic or ugly. The two terms essentially form an awareness component. For the purpose of this study, frequency of visibility is measured by the average daily traffic (ADT) rating of the highway. These figures are obtained from the District Engineer of the Texas Highway Department of Highways and Public Transportation. Where data are not available by actual count the engineers are consulted to obtain a reasonable estimate of the traffic load. The duration of visibility is simulated by computer model based on average driving speeds.

The awareness component of the model can be expressed mathematically as $(f \cdot t)$ where:

f = the frequency of visual contact measured in the thousands of occurrences/day

t = the duration of visibility at the average highway measured in seconds

At this time we are not weighting frequency (f) or duration (t) in the model but we believe that as our work progresses further we will find that frequency (f) will have to be weighted heavier. This can be handled quite simply by adding an empirical constant to the basic equation. In addition the entire awareness component may eventually have to be weigh d by an additional constant.

The second term of the model considers th inverse relationship between landscape diversi (complexity) and order (neatness). The logic behind this hypothesized relationship is that the sum of individually attractive parts does not necessarily equal an attractive whole. To be attractive or scenic, a landscape must have a number of components to generate visual inte est and at the same time there must be a harmo among the components to achieve scenic quality

This component is called the quality inde It is expressed by the term $\frac{d}{o}$ where:

d = the number and value of physical land-scape elements present on a site ranke on a scale of 0 to 9.

0 = the value of order characteristics ranked on a scale of 9 to 0.

Application

Based on field evaluation of Grimes County four categories of variables were identified that contribute to landscape diversity and thre categories of variables effect order. These are summarized in Tables 1 and 2. These tables do not list the data in the same way they are stored in the computer. They are shown here to illustrate the major factors that contribute to diversity and order.

In the early field work it was not clear how the order term in the landscape quality index hypothesized could be measured, however, further study of base data overlays revealed that there was a strong correlation between the resource area, soil and surface geology. The net effect of these three variables shows up in the vigor and mix of the vegetation, particularly with respect to grasses and understory.

Table 1.

Variables Affecting Diversity of Landscape Units

1 Structures	2 Vegetation	3 Land Use	4 Land Character
Barn & Residence	Post Oak Savannah	Crops	Bottom
Barn(s) only	Post Oak Forest	Pasture	Rolling
Residence only	Elm - Water Oak	Range	Sharply Rolling
Tanks	Pine Forest	Forest	Hilly
Wells (oil & gas)	Pine/Hardwood	Residential	
Power Station	Crops	Rural Residential	
Pens (other than wood)	Pasture		
Wood Fences	Range		
Other Buildings			

Table 2.

Variables Effecting Landscape Order

Resource Area	Surface Geology	Soil
East Texas Timberland	Fleming	Gowen
Blackland Prairie	Alluxium	Muller - Hardwood
Clay Pan	Whitsett	Navasota
Lower Trinity River	Catahoula	Lakeland
Lower Brazos River	Yegua Jackson	Lufkin - Edge
		Lufkin - Tabor

A good example of this is in photographs in Figures 9 and 10. Figure 9 has a ragged, unkept look and was cited once in the survey as being ugly, while Figure 10 was cited four times as being scenic. In this case several things seem to contribute to the low order value of Figure 9. The forest vegetation is anomolus to the resource area, the soil is very unfertile clay and the geologic formation is not a water bearing strata. So far this way of measuring order has proven rather reliable. As one might expect even intensive management cannot compensate deficiencies in the resource.

The measurement of diversity was much easier since it involves a simple inventory of common resource planning variables. Most of the information can be obtained from USGS maps and aerial photographs that can be obtained from the ASCS. The vegetation classification could have been a problem but fortunately the state of Texas has been mapped by the State Parks and Wildlife Department from LANDSAT data. Field checks have proven the maps about 85 percent accurate which has proven sufficient so far.

All of the data given in Tables 1 and 2 havebeen computer coded using a 1000 ft (304.8 m) square grid cells, approximately 23 acres (9.29 ha). The cell size is based on the assumption that it requires a land area on the order of 100 acres to form a landscape unit that is perceived as a whole. Smaller areas tend to be point occurrences that cannot be effectively predicted at the scale of this study. Therefore, the 1000-ft square cell provides four data points for a minimum unit.

To give a general idea of how the data are modeled, consider a group of adjacent cells as illustrated in Figure 11.

These cells represent a single viewshed with a common t factor of .30 seconds and an f factor of .750 (ATD in thousands of units per

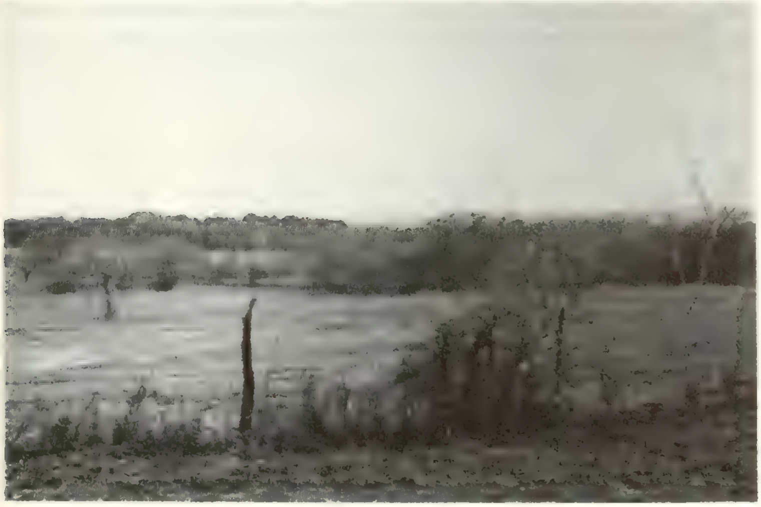


Figure 9.

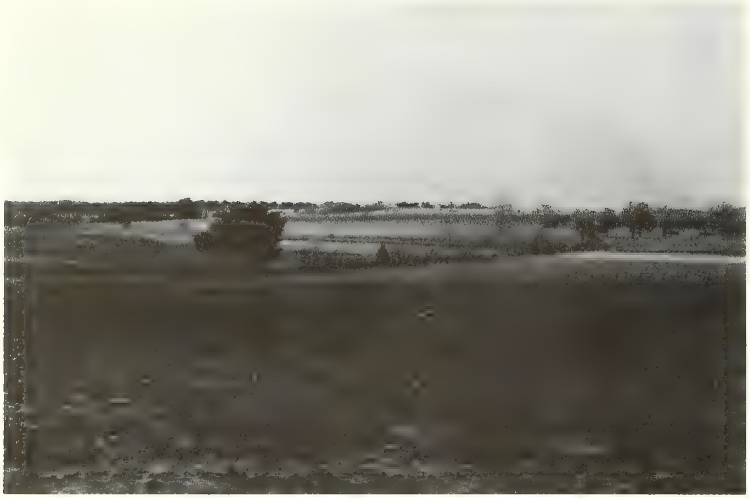
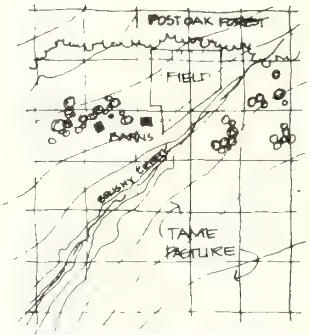


Figure 10.

Figure 11.



THIKTY CELL VIEW SHED

t= 30 SECONDS
f = .750

SOIL: POOR
GEOLOGY: POOR
RESOURCE AREA: GOOD

day), thus the awareness component is .750 x 30 = 22.50. The diversity values are obtained in three stages; foreground, middle ground and background. For the foreground, 3,000 feet, the most desirable condition is improved pasture. The least desirable is structures other than fences. Other combinations of events are ranked between. For the middle ground, 3,000 feet to 7,000 feet, a variety of buildings and vegetation is most desirable, i.e., all post oak forest has a low value. Finally, the background is considered for contrast. If a defined background is present it is a plus. If no background is present, i.e., the middle ground terminates the view, then the background value is 0.

In this case the viewshed has a high foreground rank because of the pasture and the creek. Likewise, the middle ground will be reasonably high with the barns, crops, savannah and forest. Background is lacking however, so no addition is made for background. The net val of the cells in the viewshed is:

Foreground	8.5 of 9
Middle Ground	7.8 of 9
Background	0 of 5
Total	16.3

The order value for these cells is the average of the soil, geology and resource area scores for all cells. In this case the soil and geology values are high; indicating poor soil and geology, but the resource area is good which nets a neutral order value.

Geology	7.6
Soil	8.2
Resource	2
Total	17.8

Therefore the quality index is:

$$\frac{16.3}{17.8} = .92$$

Under this system, values around one are average.

The overall scenic quality index for this viewshed is:

$$22.50 \times .92 = 20.70$$

For an area to be scenic, it needs a value of 30 or greater.

In this example the computed viewshed is only thirty cells, therefore, t, the duration of visibility decreased the awareness factor of the equation. Likewise, the potential for a high diversity value is reduced which is consistent with the hypothesis, and this is the major reason the example ranks low. One big problem that this model presents is that the index will not pick up highly scenic point occurrences as mentioned earlier. It is also possible that if a particular population has a preference for closed scenic corridors there are some questions about how the data can be modeled to predict them successfully.

These problems are not critical to the work being accomplished in Texas, largely because of the scale of the project (± 2,000,000 acres) and since the primary objective is to identify major scenic units that will affect mine management and reclamation techniques. The problems may be insurmountable however, if one attempted to apply the technique to small landscapes or forest land, for example.

CONCLUSIONS

At this time it would appear that a successful set of objective descriptors have been devised that can be empirically modeled to reproduce a map that matches the public's idea of scenic landscapes, but it cannot be stated with any degree of certainty, at this time, if the system will work well when applied to a similar landscape until more testing is done. This work is underway now and we are encouraged by what we are finding so far.

To test the hypothesis described further we have selected two additional study areas within the same geographic region that have, in our opinion, similar visual characteristics, Milam County and Freestone County. The same empirical model used to produce the Grimes County map will be used to evaluate both Milam and Freestone couties. During the same period a public survey will be conducted identical to the Grimes County survey. The results of this work will then be compared to see if there is sufficient correlation.

What is most encouraging at this time is that we have done some quick hand overlay studies to make some initial predictions. A windshield survey seems to verify that scenic areas can be identified from the natural resource data with fair accuracy. What we do not know is whether the people of Freestone and Milam counties are of the same mind as the population of Grimes County, and we will not know for sure until mid-August of 1979.

If this work goes as it is hoped, the entire lignite belt will be mapped and evaluated for visual sensitivity using this system.

While the system presented here shows a great deal of promise and raises some exciting new questions, the value of the work is not the system itself. The major benefit will be the landscape management implications brought forward by understanding the landscape better and translating this to better design and lower costs. One very good example of this has already been inferred from our early work. One of our early concerns about surface mining was that the removal of all surface vegetation and reclaiming to pasture would meet with unfavorable response. This appears to be almost the reverse of the truth, as evidenced by the high scenic value of pasture versus forest. Speculation about why is of no value here. What is important is that we are learning.

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Computer-Aided Visual Assessment in Mine Planning and Design[1]

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J. LeRoy Balzer [3]

Roger E. Nelson [4]

Abstract: A computer modeling technique is described for evaluating the visual impact of a proposed surface mine located within the viewshed of a national park. A computer algorithm analyzes digitized USGS baseline topography and identifies areas subject to surface disturbance visible from the park. Preliminary mine and reclamation plan information is used to describe how the surface disturbances will be sequenced over time. Data from revegetation plots incorporated into the model account for disturbed areas that are returned to the viewscape. These quantitative results are displayed on a computer-generated three-dimensional perspective. The need for further work, including qualitative evaluation is discussed.

INTRODUCTION

Utah International Inc. is a major mineral development corporation that conducts surface and underground mining operations around the world. Our mineral products include copper, iron ore, uranium, and coal. Uranium is produced through a wholly-owned subsidiary. Our producing domestic coal mines are located in northwestern Colorado and in Four Corners, New Mexico. We are actively seeking opportunities to develop additional domestic coal reserves.

Utah holds leases and various agreements for 27,000 acres of coal in the Alton coal field of southern Utah. The extreme eastern end of the coal reserves lies within the viewshed of Yovimpa Point overlook of Bryce Canyon National Park. The distance from the overlook to the extreme eastern end of the mine area is about 5.0 miles. It is estimated that this view is enjoyed annually by up to 250,000 visitors to the Park, with spectacular vistas of up to 80 miles on some days.

As part of our environmental assessment, Utah developed baseline data of the normally considered physical and cultural factors, including the visual resource. Because this scenic resource is of unique value, careful consideration of the visual environment is being integrated into the planning and design of the proposed mine.

THE PROCESS

This paper describes our use of a computer technique developed by Comarc Design Systems to assess the project's visual impact on the viewshed of the Park. The assessment process included the following steps:

1/ Presented to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

2/ Environmental Planner, Department of Environmental Quality, Utah International Inc.

3/ Director, Department of Environmental Quality, Utah International Inc.

4/ Manager, Department of Environmental Quality, Utah International Inc.

- Describe the landform alteration;
- Locate and quantify the visually sensitive areas; and
- Evaluate the results.

Landform Alteration Description

Visual impact should be assessed in the context of the process that is altering the landscape. Surface mining is a dynamic process where landform alteration continues from surface disturbance during mineral extraction through recontouring and revegetation, until the land has been returned to its condition prior to mining.5/ An important reclamation objective at the Kanab site is that the reclaimed landscape blends visually with its surroundings. A properly designed reclamation site that incorporates visual objectives during the planning process should present no long-term adverse visual impacts.

Quantify the Visual Impact

A. Technique Selection

There are several approaches to quantifying the visual impact including graphic analysis, photography, physical models, computers and combinations thereof. The computer was selected for this visual assessment because it provides:

- Rapid and accurate identification of visible mining areas;
- Ease in changing input data, such as mining area location and status;
- Rapid and accurate overlay of view cell data with other information;
- Display of analytical results in computer generated three-dimensional displays.

In summary, the planning team felt that the flexibility and quick response provided by the computer would provide a desirable planning tool.

B. Description of the Analytical Process

The steps involved in the computer visual assessment are:

1. Identification of the study area,
2. Digitization of topography,
3. Geometric analysis of visible areas,
4. Three-dimensional display of those areas

1. Study Area

The study area included mining areas with the general viewshed of Yovimpa Point. It was selected based on the experience of thos who had visited Yovimpa Point and by a qualitative examination of 1:24000 USGS topograph quadrangle maps.

2. Digitization

Digitized 40-foot contour intervals from a USGS base map provided a data bank for the view cell analysis and for later production of the computer-generated three dimensional displays. This data bank consists of 4-acre "view cells" with specified elevations.

3. Geometric Analysis

The algorithm used to determine whether an individual view cell could be seen from Yovimpa Point, depicted in figure 1, established a visual line-of-sight from this view point to an individual view cell. If a landform is encountered along the sight line, i.e., if an object between the view cell and the observation point is above the line-of-sight, then the view cell is not visible.

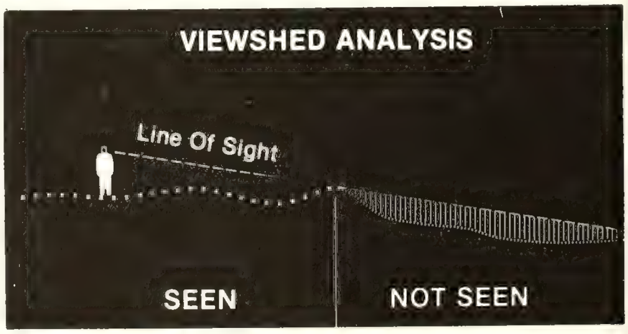

Figure 1--Visual line-of-sight algorithm used in computer model

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5/The authors recognize provisions in regulations pursuant to the Surfact Mining Control and Reclamation Act of 1977 describing conditions for planning "afternative land uses."

A two-dimensional view cell map identifies individual grids within the viewshed of the Park that are seen from Yovimpa Point. The computer then compares these view cells with an overlay of the mining area and differentiates between the visible and non-visible portions of the proposed mine (fig. 2).

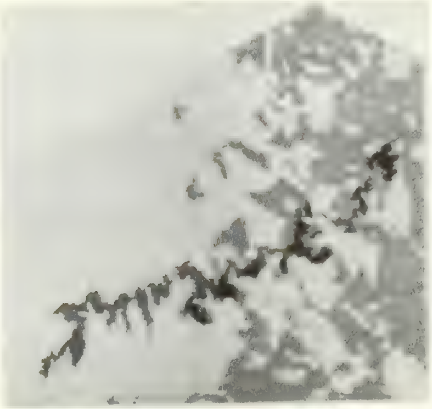

Figure 2--Two-dimensional viewcell map identifying surface-mined areas visible from Yovimpa Point (shown in black). Dark grey areas identify non-mining viewcells seen from Yovimpa Point.

4. Three-Dimensional Display

This information is then displayed on a three-dimensional plot which is produced from the same digitized topographic information used to identify visible mining areas. This is an important step because displaying the information in three-dimensional form more clearly communicates the analytical results.

During the initial phase of our study, technical limitations in the computer software did not allow for a three-dimensional plot of the study area as seen precisely from Yovimpa Point. Therefore, it was not possible to illustrate directly the visible mining areas as viewed by an observer standing on the Point.

As an alternative, the visible areas were overlaid onto a three-dimensional perspective prepared from a different vantage point. This "birds-eye" view is several miles back from and above Yovimpa Point. The result, shown in Figure 3, allows the viewer to observe the viewshed simultaneously from two different vantage points. This three-dimensional picture depicts a much broader vista at an exaggerated vertical scale to provide the viewer with a highlighted perspective emphasizing landscape features, while the overlaid view cells precisely identify those areas that would be seen if the viewer were standing on Yovimpa Point.

Evaluation

Until now, this study had accomplished two important objectives:

1. The areal extent and location of the visible surface disturbances had been quantified.

2. The analytical results had been displayed in three-dimensional form.

It became clear to the planning team, however, that a single perspective which simultaneously depicted views from two vantage points was not an easy concept to grasp. The landforms visible from the birds-eye view could be confused with the visible areas seen from Yovimpa Point identified on the overlays.

A second fundamental shortcoming of these initial results was that the study failed to incorporate the mining sequence into the analysis. The total potential surface disturbances during the entire life of the mine were depicted as though they would occur simultaneously.

To refine the study further, a preliminary mining schedule which specified mining sequences by blocks of coal seam units was incorporated into the model. Although this preliminary schedule does not contain the design detail needed for the final mine plan, it does provide a measure of the rate at which surface disturbance would proceed. Reclamation of these disturbed areas is an integral part of the mining sequence, and includes back-filling, recontouring, and revegetation. In keeping with experience at our other western coal mines, as well as with new requirements pursuant to the Surface Mining Control and Reclamation Act

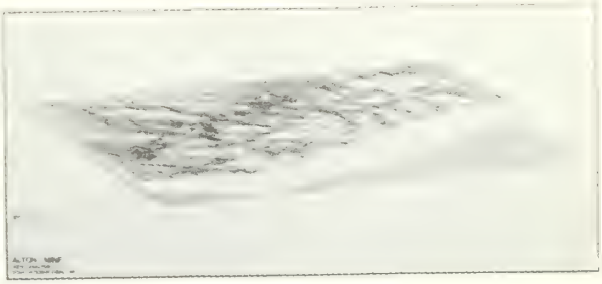

Figure 3--Viewcells mapped from Yovimpa Point overlaid on three-dimensional "birds-eye" perspective as seen from behind Yovimpa Point.

of 1977,[6/] reclamation will proceed at a rate equal to the rate of surface disturbance. Test data acquired since 1975 at the site indicate that native species will be established within about three years of seedling.[7/]

With this new information, it was possible to describe visually the location, areal extent, and time of surface disturbances visible from the Park, and to estimate when disturbed areas would be "returned to the viewscape" by reclamation. Because the mining sequence data are preliminary, time intervals of 5 years were selected.

While these efforts to integrate the mining sequence into the visual analysis were carried out, further attempts were made by Comarc Design Systems to overcome the technical difficulties encountered in producing a perspective as seen from Yovimpa Point.

In order for the computer algorithm to place the viewer directly on Yovimpa Point, it was necessary to slice off a portion of the study area (not including mining areas) directly in front of the view (fig. 4). The resulting perspective is shown in figure 5.

PHASE II RESULTS

For each five-year sequence, those visible areas in a state of active temporary surface disturbances are portrayed in three ways:

1. View cells are shown in two-dimensional form, for precise analysis;
2. View cells are overlaid on the birdseye view perspective, for emphasis;
3. View cells are overlaid on a three-dimensional perspective as observed by a viewer standing on Yovimpa Point, for a precise display of the visual impact.

These preliminary results indicate that no surface disturbances will be visible during the first five years of mining from 1985-1990. Cyclical levels of visible disturbance will occur during the years 1990 to 2010. Surface disturbances will also occur during the later stages of the mining sequence in the eastern blocks during the years 2010 to 2020. Even at the later stages of mining, no more than 10% of the mining area under study would be subject to active surface disturbance within a given 5 year study period. Within 5 years after surface mining is complet the reclaimed land will be fully returned to the viewscape Examples of these results are illustrated in figures 6A, B, and C.

Figure 4--Segmented study area to produce three-dimensional perspective as seen by observer standing on Yovimpa Point.

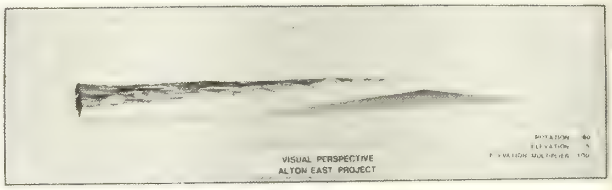

Figure 5--Three-dimensional perspective depicting view from Yovimpa Point

The second phase of this study has accomplished three important objectives:

6/Federal Register, Vol. 44, No. 50, B16.100, Contemporaneous Reclamation: "Reclamation efforts ...of all land disturbed by surface mining activities must occur as contemporaneously as practicable with mining activities."

7/Joint study, USFS, Utah International, Inc. The objective of this study was "To determine the relative success of establishment and subsequent longevity of several species...on topsoil...and overburden." While visual quality was not considered in the study, we use the results as a best available information source. Further evaluation may be required.

1. It has integrated the mining and reclamation process into the visual analysis;

2. It has more accurately defined the visual impact by quantifying the location, areal extent, and timing of the disturbance;

3. It has accurately portrayed those impacts in three-dimensional form as observed from Yovimpa Point.

We conclude from these results that the computer is an effective and versatile tool for quantifying and displaying visual impact. As mine planning proceeds into more detailed studies, the established data bank will also provide our planning team with a useful tool for incorporating environmental concerns, especially the visual environment, into the planning process.

CONTINUING PROGRAM

These results are only the first step in Utah's total program to assess and preserve the visual environment. Other studies in progress include descriptive and quantitative classification using photointerpretation of the landforms in the viewshed beyond the mining area to establish a baseline visual environment. This study has identified landform alteration from range improvements and private farming.

Our ability to achieve visual design objectives will be measured by our performance. The efforts described in this paper, however, underline UII's commitment to include all important environmental values, including the visual environment into our mine planning and design.

Figure 6a--Two-dimensional map depicting disturbed surface area visible from Yovimpa Point during the years 1990-1995.

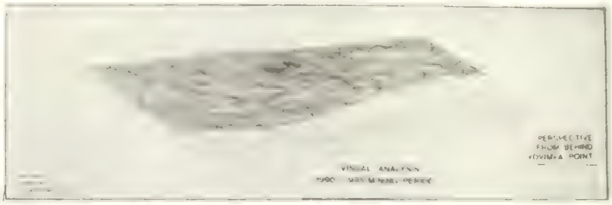

Figure 6b--Three-dimensional birds-eye view from behind Yovimpa Point depicting disturbed surface areas visible from Yovimpa Point during the years 1990-1995.

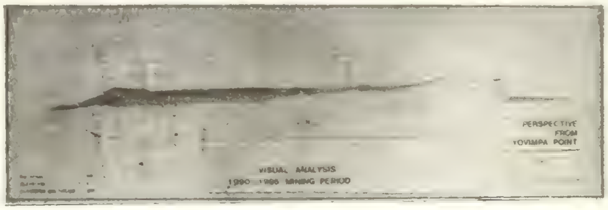

Figure 6c--Three-dimensional view from Yovimpa Point depiciting disturbed surface areas visible from Yovimpa Point during the years 1990-1995

Opportunities for Visual Resource Management in the Southern Appalachian Coal Basin[1]

John W. Simpson[2]

Abstract: This paper outlines the opportunities for visual resource management (VRM) in the southern Appalachian coal basin resulting from the Surface Mining Control and Reclamation Act. It focuses upon VRM as a regulatory activity that works to insure the proper enforcement of the law and effective development of its implementation programs. VRM for Appalachian surface mining is directly controlled by the law which can significantly protect the region's visual resources given proper enforcement and program development. However, the full environmental, economic and social costs of achieving the potential visual benefits are not fully known.

INTRODUCTION

The Tennessee Valley Authority (TVA) has long been concerned with the visual impacts resulting from the surface mined coal the agency purchases. Anticipating a change in Federal and State regulatory roles because of pending legislation, TVA renewed efforts in early 1977 to define the visual impacts of surface coal mining, and develop, test and implement a method enabling the agency to manage the visual resources of the Tennessee Valley and surrounding regions more effectively.

This paper outlines the results of these efforts and the opportunities for visual resou management (VRM) in the southern Appalachian coal basin resulting from the Surface Mining Control and Reclamation Act. It focuses upon VRM as a regulatory activity that works to ins proper enforcement of the law and effective development of its implementation programs. VRM in this context is a regulatory effort aimed a positively influencing, preserving or enhancin the visual resource at a statewide scale for both abandoned mine lands and future mining areas. The paper presents a detailed definiti of surface coal mining's visual impacts. In addition, a brief overview of the industry's development and relationship to VRM is include The paper concludes with VRM recommendations i response to the law and present mining practic

THE VISUAL IMPACTS OF SURFACE COAL MINING

Like other resources of the land, the vis resource must be properly managed to maintain acceptable standards of quality. Whether exis ing quality is enhanced or degraded is a funct of the type and extent of change to the landscape. Surface coal mining extensively change the landscape and can result in severe visual impacts. Many strip mines throughout southern Appalachia have left scars that remain visible for many years to millions of residents and tourists. In the past, little consideration o study has been given to these impacts.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

This paper was prepared by John W. Simpson, a consultant to the Tennessee Valley Authority (TVA). The contents do not necessarily reflect the views and policies of TVA.

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During stripping operations, huge quantities of earth are removed from the surface, hauled and deposited in adjacent areas, often creating dramatic changes in the natural landscape. Changes in natural landform, color and texture that create contrast between the mine and its surroundings produce surface coal mining's major visual impacts (Figs. 1 and 2). Other visual impacts can include off-site facilities such as tipples and storage areas, and downstream pollution.

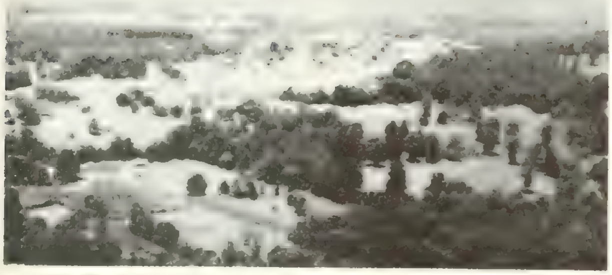


Figure 1 - *Contrast between a mine and its surroundings resulting from early mining-reclamation practices; area mine, Van Buren County, Tennessee.*

The physical change and contrast between the mine and its surroundings resulting from the mining operation vary over time. The visual impact of that change is dependent upon the viewer's perception of the modified landscape. Discussions of surface mining's visual impacts must, therefore, include the characteristics of both the physical change and the viewer.

Characteristics of the Physical Change

Surface mining's visual impacts are secondary impacts resulting from a fundmental mining activity and its associated environmental impacts. Improper placement of overburden, toxic materials and topsoil, and inadequate drainage and revegetation can result in many environmental impacts including landslides, erosion, stream siltation and acid mine drainage. These primary impacts create the contrast between the mine and its surroundings that may be perceived by the viewer as visual impacts.

These impacts are a function of time-- the amount of time necessary for the area to regenerate itself to the point where it either blends into the original landscape or the modified landscape is visually acceptable. Because the life of an active mine is very short in relationship to the amount of time necessary for the acceptable blending of the mined area into the visual landscape, concern for the visual impacts of active mines should be minimal. Primary concern should be given to the long-term visual impacts of the reclaimed area.

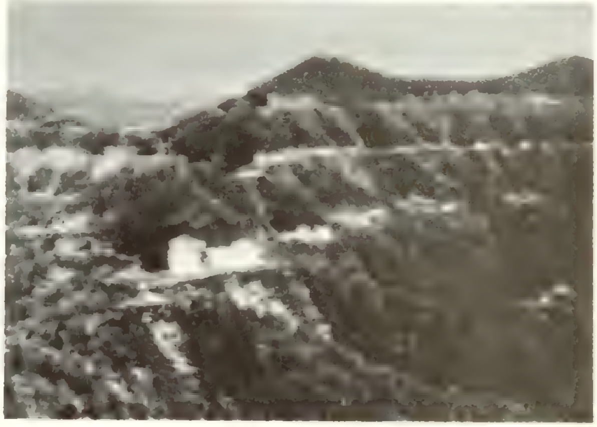


Figure 2 - *Contrast between a mine and its surrondings resulting from early mining-reclamation practices; steep slope mine, St. Charles, Virginia.*

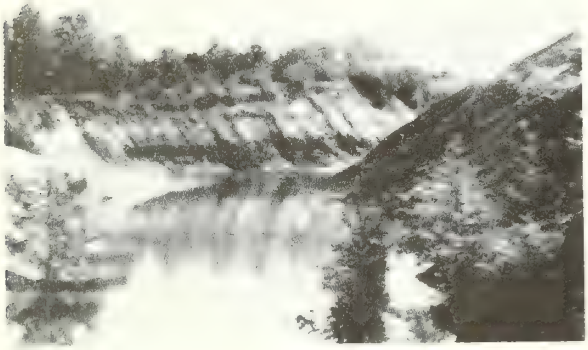
The amount of time necessary for the mined area to become visually acceptable, the duration of the visual impacts, is primarily influenced by the physical characteristics of the mine and the perceptual characteristics of the viewer. The mining-reclamation technique, the soil, overburden and seam characteristics, the post-mining landuse, and the visual absorption capacity of the landscape determine the physical duration of the impact (Figs 3. and 4).

Perceptual Characteristics

Perceived visual impacts (both magnitude and duration) are greatly effected by the characteristics of the viewer, the viewing location and the view. A resident of Hardburley, Kentucky (Fig. 5), can be expected to form a slightly different aesthetic reaction to a view of a surface mine than a tourist from Cleveland, Ohio (Fig. 6). Their unique perceptions of the same view are equally valid.

Intuitively, many people believe the majority of people feel strip mines are ugly and should not be seen. Most of the literature and thinking on surface mining VRM has been based upon these assumptions. Yet little if any research has been conducted to establish clearly the public's aesthetic perception of surface mines.

Figure 3 - *Improper reclamation of a small area mine, Van Buren County, Tennessee.*



The identification of the public's perception of surface mines is extremely difficult. A person's perception of a mine is intertwined with the perception of the entire surrounding landscape including past mining practices, logging and farming activities. A person's understanding of the industry, whether based on fact or rumor, and that person's involvement with the industry also influence the perception of the mines. Research is necessary to establish the public's aesthetic attitudes on surface mines to enable a strong rationale for VRM efforts.

Intuitively, many people also believe the public's attitudes toward surface mines are greatly influenced (or should be) by the visibility of mines. Contrary to popular belief, most southern Appalachian strip mines are not highly visible from major roads and communities. Most steep slope mining takes place on the upper portion of a mountain. Consequently, the mines usually cannot be seen from roads and communities in the valleys because they are screened by vegetation and the curvature of the mountainside. Area mining on gently rolling slopes is also usually screened by vegetation and topography. Although significant contrast between the mine and its surroundings may exist, the perceived visual impacts of the mine may be minimal if few people see it. The relationship between the magnitude of a mine's visual impact and its visibility is debatable.

A person's perception of a mine will also be affected by a) distance from the mine; b) orientation to the mine; c) the importance of the viewing location (state park or an abandoned mine); d) the duration of the view; e) the time of day, weather and season; and f) the condition of the areas surrounding the mine. Accurate generalizations about the magnitude or duration of surface mining's visu impacts are obviously very difficult to formulate.

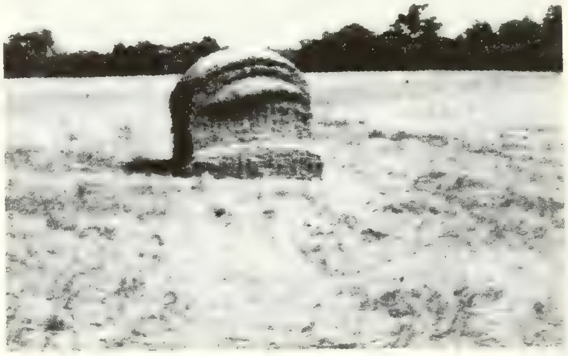


Figure 4-- *Proper reclamation of a small area mine reduces potential visual impacts, approximately one year after mining; Jamestown, Tennessee.*

PREVIOUS EFFORTS AT VRM FOR SURFACE COAL MININ

Prior to the implementation of the Surfac Mining Control and Reclamation Act, efforts to control the visual impacts of southern Appalachian surface mining were sporadic and inconsistent. The development of the industry can be divided into three phases. The initial phase began immediately following WW II and lasted until the passage of state reclamation laws in the mid-1960's. During this time, improvements in earth-moving capabilities together with changing coal markets stimulated the use of surface mining as an economically feasible and significant means of coal production, but "Unfortunately, the early acceleration of coal surface mining was largely uncontrolled and too often environmentally reckless." (Curry 1977).

Before state reclamation laws, few stripping operations were conducted with regard for the environment and most resulted in severe visual and environmental impacts. Tens of thousands of acres were drastically disturbed in Appalachia with little or no reclamation. Decades will be necessary to hide thousands of miles of exposed highwall, to clean polluted streams, to stabilize landslides and to replenish lost topsoil and vegetation resulting from uncontrolled mining.

VRM efforts during this period centered on cooperative tree-planting programs conducted by various Federal, state and industry groups. These programs were in part aimed at improving the appearance of abandoned mine lands. The programs were small, shortlived and provided little relief to the enormous problem.

The state mining and reclamation laws reduced some of strip mining's environmental impacts and thus the visual impacts by regulating outslopes and requiring basic revegetation. But, enforcement problems in many areas limited the effectiveness of these laws. Improper handling of topsoil and spoil materials, and slow reclamation work continued to cause major environmental and visual impacts. Even under strict compliance with these initial reclamation laws, significant visual impacts could still result. The environmental controls alone were inadequate to achieve effective control of the visual impacts.

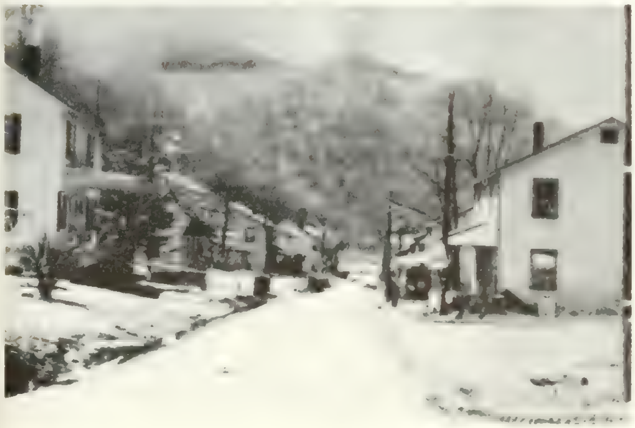


Figure 5 - *Perception of surface mines is intertwined with perception of the entire environment; Hardburley, Kentucky.*

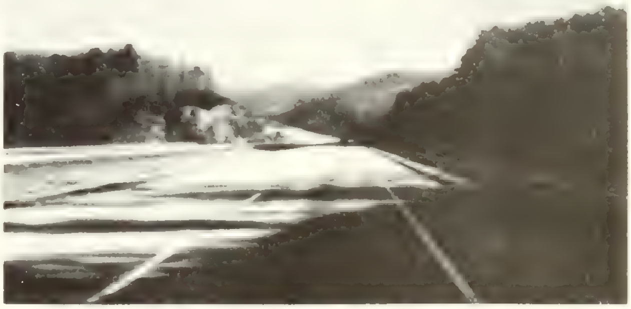


Figure 6 - *A dramatic view of a surface coal mine visible to millions of tourists; I-75 Northbound, London-Corbin, Kentucky.*

Increased public awareness and concern for surface mining's unchecked environmental effects triggered the second phase in the industry's development. Reacting to public pressure, the Appalachian states made enormous efforts between the mid-1960's and the mid-1970's to regulate the mining-reclamation techniques: "In the mid-1960's the reclamation arms of Kentucky and West Virginia, working with other state and Federal agencies and the coal industry, began the first serious efforts to improve surface mining techniques in central Appalachia...The major trust of these early efforts was to keep overburden closer to its original placement" (Curry 1977).

In addition to the initial regulatory efforts at environmental and visual controls, numerous site specific reclamation projects were conducted. These projects clearly established the ability to make productive use of mined lands when proper planning and mining-reclamation techniques were used. However, the majority of initial efforts at controlling visual impacts were after-thoughts rather than integral parts of the mining process and remained linked to environmental controls. Mining continued to devastate the region's visual resources because management efforts did not directly address the causes of the problem at a sufficient scale.

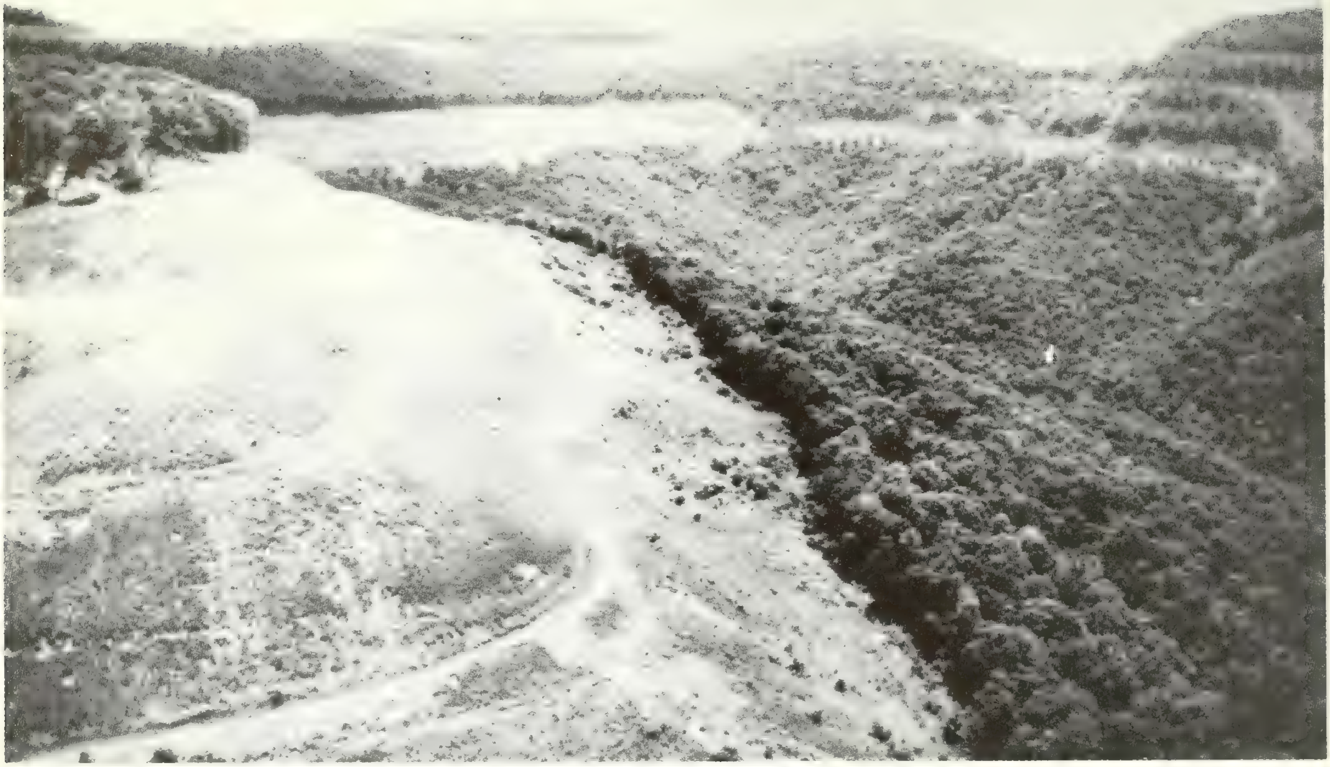


Figure 7 - *Reclamation of a multiple-seam, steep slope mine similar to standards established by the new law; Massengale Mountain, Campbell County, Tennessee.*

WHAT IS VRM FOR APPALACHIAN SURFACE MINING?

Visual resource management for Appalachian surface mining is directly controlled by the Surface Mining Control and Reclamation Act. The act can adequately protect the regional visual resource from the vast majority of surface mining's visual impacts and establishes programs to fund the reclamation of inadequately reclaimed lands and waters. VRM efforts should concentrate primarily on assisting in the development and implementation of state Abandoned Mine Lands Reclamation and Lands Unsuitable for Surface Coal Mining programs. VRM in this context is a large scale, regulatory effort aimed at positively influencing, preserving, or enhancing the visual resource at a statewide scale. Proper enforcement of the law will also do much to alleviate visual impacts and should be facilitated whenever possible.

Because these programs will be specific to the needs, conditions and administration of each state, it is inappropriate to outline standard VRM methods or recommendations for these programs. They are best discussed as portions of a specific state's program, and in response to the state's full surface mining administration and industry.

The secondary emphasis should be on the detailed planning and reclamation design of specific areas either for lands disturbed prior to the law, or special designated areas within the law. VRM at this scale is a site design problem and will vary for each site.

Although the law can satisfactorily control surface mining's visual impacts, effective enforcement of many environmental protection standards, including back-to-contour criteria, may prove difficult. These standards will be continually challenged by landowners and the mining industry. Federal and State administrations will be pressured to grant variances from these standards based upon the landowner's desire to return the land to a "higher or better landuse." It is not clear whether the administrations will deny such petitions on visual criteria.

The Surface Mining Control and Reclamation Act presents the opportunity to protect significantly southern Appalachia's visual resources from surface coal mining given proper enforcement and program development. The full environmental, social and economic costs of achieving the potential visual benefits are not known.

SURFACE MINING CONTROL AND RECLAMATION ACT

In 1967, the U.S. Department of Interior published a national report titled, "Surface Mining and Our Environment,"(USDI 1967) that documented the devastating impacts of surface coal mining. The report was a response to the continued public outcry on the impacts of standard mining practices. It made a strong appeal for more effective controls based on statistical information, and emotional and visual concerns. The report became a starting point for the development of national controls.

These concerns culminated in the enactment of the Surface Mining Control and Reclamation Act in 1977. Through the law, Congress recognized surface coal mining as a fundamental and viable source of energy that must be given an increasingly important role in supplying national energy needs. They also set standards to insure that surface mining will be conducted in an environmentally, socially and visually acceptable manner.

New mining-reclamation standards focus on the requirement that all future mined lands be reclaimed to their "approximate original contour" (Fig. 7). This standard is based primarily on emotional and visual concerns as evidenced by the lack of documentation on the environmental effects of back-to-contour mining. Virtually no conclusive evidence on these impacts existed prior to the law. The law established a strong, new direction for surface mining in order to satisfy the public's emotional and visual reaction to surface mining.

The law's consideration of the visual environment can be divided into two categories: (1) reclamation of lands disturbed by prior mining practices; and (2) regulation of present mining practices. All lands and waters disturbed by prior mining practices and inadequately reclaimed are eligible for reclamation funds distributed through the Federal Office of Surface Mining (OSM). Reclamation of abandoned mine lands will occur primarily through each state's Abandoned Mine Land Reclamation Program and the USDA Soil Conservation Service's Rural Abandoned Mine Program, (R.A.M.P.).

A state Abandoned Mine Land Reclamation Program lets specific reclamation work contracts based upon a statewide reclamation plan and site screening process. The Final OSM Abandoned Mine Lands Program Rules[3/],place highest reclamation priority on lands and waters presenting existing or eminent danger to the public's health, safety and welfare; after reclamation of these areas, priority is given to areas that satisfy a range of objectives concerning general environmental quality and public welfare. Concern for the visual environment is one of the many stated objectives. General ranking of lands to be reclaimed and selection of specific reclamation sites will be in some part determined by visual concerns. These concerns may also be incorporated into the final design of a specific site's reclamation plan.

Concern for the visual environment is also fundamental in portions of the law that regulate present mining. Congress established as national policy that the vast majority of surface coal mining, as regulated by the law, will adequately preserve the nation's visual resource. This they insured by the establishment of environmental protection criteria partially developed because of their effectiveness at protecting the visual resource. These include back-to-contour, proper handling of topsoil and toxic materials and prompt revegetation standards.

Only under special conditions did Congress feel that the visual impacts resulting from the prescribed mining practices will require additional controls to adequately protect the nation's visual resource. Such conditions allow each state to designate certain lands as unsuitable for surface coal mining based in part on visual criteria[4/] this also applies to all Federal lands. Standard permitting procedures and requirements do not specifically consider the visual impacts of the proposed mine although the required reclamation plan may respond to VRM criteria.

It is the author's opinion that the law can adequately protect the visual resources of southern Appalachia through its environment protection criteria, lands unsuitable for surface mining, abandoned mine lands and R.A.M.P. programs. The law strikes an appropriate balance between the preservation of the visual resource and the national need for coal. Administration of the law and program development has been properly placed in each state allowing the necessary response to specific industry, regulatory and administrative practices.

[3/] See Section 874:13, U.S. Department of Interior, Office of Surface Mining Reclamation and Enforcement, Abandoned Mine Land Reclamation Program Final Rules, 43 F.R. 49932, Wednesday, October 25, 1978.

[4/] See Title V: Control of the Environmental Impacts of Surface Coal Mining, Section 522 - Designating Areas unsuitable for Surface Coal Mining, of the Surface Mining Control and Reclamation Act.

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Visual Analysis as a Design and Decision-Making Tool in the Development of a Quarry[1]

Randall Boyd Fitzgerald[2]

with technical assistance from
Jessie Pflager

Abstract: In order to obtain local and state government approvals, an environmental impact analysis of the mining and reclamation of a proposed hard rock quarry was required. High visibility of the proposed mining area from the adjacent community required a visual impact analysis in the planning and design of the project. The Visual Analysis defined design criteria for the mining and reclamation plans to minimize adverse environmental impacts and encourage long-term beneficial land use. Visual analysis provided an additional tool for the citizens, local government, and state government officials to evaluate the proposed mining activity.

INTRODUCTION

One application of visual analysis is as a design tool in site specific mining and reclamation plans which are responsive to the surrounding environment. Constructive use of visual analysis was an important element in the planning of a proposed mining site west of the Denver Metropolitan Area. This paper illustrates the application, on a local scale, of a visual analysis process used in planning, design and evaluation. The consultant's role was the coordination of studies and preparation of plans and documents required for mining permits to extract and process the hard rock on the site for use as gravel in the Denver Metropolitan Area. The site was predetermined by the client. The initial mining concepts involved expansion of an existing hard rock quarry at the base of the Front Range of the Rocky Mountains.

The site is visible from a community of approximately 10,000 people and several major regional transportation corridors. As a result, the magnitude of visible change, at any time, in the natural character of the landscape of the Front Range is a critical component in the decision to allow or not allow further mining of the area. Any effort to minimize the adverse environmental effects of the proposed mining activity mandated the use of comprehensive visual resource management in both the design of the mining and reclamation plans and the local and state government approval processes.

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[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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The need for comprehensive analysis and planning, coupled with local and state requirements, required an environmental analysis of the proposed mining activity. The visual analysis was one part of the environmental impact analysis used to evaluate the potential impacts of alternative mining plans. As a result of the studies, specific design criteria were developed to minimize the adverse impacts on the geology, hydrology, vegetation, traffic, air quality, etc. of the site and its surrounding vicinity. The criteria were used to evaluate alternative plans and design the final mining and reclamation plans.

The principal objectives of the overall study were threefold:

- to obtain the necessary governmental approvals to extract the gravel,
- to minimize adverse environmental impacts on both the land and the adjacent community, and insure the beneficial long-term use of the land, and
- to aid in responsible government decision-making with regard to the issuance of approvals and mining permits.

The visual analysis of the site helped accomplish these goals by (1) defining on-site design criteria for incorporation in all phases of the mining and reclamation plans and (2) analyzing the off-site visual impacts on the surrounding land and community.

VISUAL IMPACT FACTORS

The surface mining process visibly changes the natural landscape in both landform (of a permanent nature) and character (which may be of a temporary nature). The change is not from a natural to urban environment. In this case, it is a modification of the existing landscape and the eventual reinstatement of similar natural conditions. Alterations in the landscape due to gravel mining occur in two ways:

- in the short-term, through constantly modified landforms resulting from extraction processes of mining, and
- in the long-term, through the modification of the final landform and revegetation of the land.

Visual impacts of surface mining result from both the operation of the on-going extraction process and the short- and long-term changes in the natural landscape. The operational factors which will affect the magnitude of impacts include 1) the quantity of material to be extracted, 2) the amount of land disturbed at any one time and over the life of the project, 3) the location and visibility of the mining area, the crushing equipment, haul roads and conveyor systems, 4) the rate and phasing of reclamation, etc. Additionally, the sequential use of the land after mining will also affect the magnitude of impact.

SUMMARY OF THE PROCESS

In simplified terms, the visual analysis process determined the locations and characteristics of the most visually significant portions of the proposed mining site and then developed criteria for the mining and reclamation plans which least adversely affected those areas and the community. The process is outlined as follows:

- Define the characteristics and location of the most significant portions of the proposed mining site.
- Develop mining plans to minimize adverse effects on these areas.
- Develop a reclamation plan to maintain the character of this site with the integrity of the surrounding land of the Front Range.
- Analyze the magnitude of change from the existing conditions both during the extraction process and at the completion of the final reclamation as viewed by the adjacent communities.

To accomplish these steps the community is first divided into subareas, called Rate Areas, and the characteristics of each area are defined. The site is then divided into smaller subareas, called Site Subareas, which are analyzed individually in relation to the adjacent land from each Rate Area. The result is the identification of the location and characteristics of the most significant areas of the site as viewed from the adjacent community. Mining and reclamation plans are then evaluated and selected. Since the visibility of each Site Subarea has been documented from each Rate Area, the magnitude of visual change resulting from the final mining and reclamation can be determined.

ANALYSIS PROCESS

To define appropriate design criteria for the mining and reclamation plans and to estimate the potential visual impacts of specific plans, the most sensitive and/or visually significant portions of the site must first be identified. The significance of each Site Subarea is determined by the natural characteristics of that portion of the site in relation to its surroundings (herein referred to as the qualifier) and characterized by how many people can see it, for how long and from how far away (herein referred to as the quantifier).

Predominance of Site Subareas

The existing conditions of the site are first evaluated as seen from the surrounding land and the adjacent community (fig. 3).

1. Both the site and the viewshed are divided into subareas. The site is divided into subareas using topographic change such as ridges and drainages as the criteria for area definition (fig. 1).

   The physical boundaries of the viewshed of the site are also defined. The general land use characteristics of the viewshed are defined and form the criteria for subarea definition. In this case there are three residential areas and four transportation corridors. These areas are referred to as Rate Areas, to minimize confusion with subareas of the site (fig. 2).

2. To reflect objectively, the characteristics of each of the Rate Areas, their identifying factors of number of people (refer to "a" below), degree and/or length of visual exposure to the site (refer to "b" below), and average distance from the site (refer to "c" below) was calculated.

   a. Number of people (N)
   The number of people for each Rate Area was calculated for residential areas by multiplying the number of dwelling units times their average population density[3], or for transportation corridors by multiplying the average daily traffic count by 1.5 people/car.

   b. Time of Exposure (T)
   The degree of visual exposure was the anticipated time that the viewers within the area could see the site or a portion thereof. In the residential areas the yearly average daylight hours were found for the Golden latitude and longitude. The transportation corridors were driven at their respective speed limits and timed[5]. These calculations indicated average daily time the viewers within a rate area would be exposed to the site.

   c. Distance from the Site (D)
   Average distance was found by drawing a series of ¼ mile concentric circles radiating from the site. Each Rate Area was given its distance factor according to the number of circles it fell within and their distance from the site.

   The factors resulting from each of the above characteristics are multiplied to produce one "quantifier" for each of the seven Rate Areas.

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[3] City of Golden Planning and Zoning Department records.

[4] Average vehicle occupancy rate, Denver Metropolitan Area, Denver Regional Council of Governments.

[5] The speed limits of the different roads varied from 40 to 55 mph.

3. An evaluation of the Site Subareas was next conducted. Each of these Site Subareas was evaluated from each Rate Area. This was done through an examination of the elements that create visual prominence in a mountain landscape; visibility, orientation to observer, color and texture in relation to surrounding areas, and ridgeline dominance. "Visibility" defines whether the Site Subarea can be seen from that part of the community; "orientation" describes the degree which the Subarea faces the observer and the seasonal and/or vegetative characteristics which may affect its significance, i.e., snow accumulation. "Texture and color" address the variation and characteristics of the vegetation and rock outcropping in relation to the adjacent areas; and "ridgeline dominance" defines the significance of the ridges based on whether they define the skyline profile of the mountain or serve to define topographic change and overall landform.

   Because each Site Subarea is a different size, the acreage of each was considered another contributing factor in qualifying the significance of the subarea. Each of the subjective "qualifier" scores was multiplied by the acreage to reflect the size differential (fig. 1) and provide a "qualifier" for each area.

4. The qualifying score for each site subarea is multiplied by the rate area quantifier score, giving a prominence score. This is calculated for each rate area. Each prominence score is added together to give a Total Prominence Rating for the Site Subarea.

Design Criteria

The process has now documented the significant natural characteristics of the site to be used as important criteria for both the mining and reclamation plans. These criteria included:

Vegetative zones --
The extent, coverage, orientation, type, texture and color of areas of predominantly grass vegetation, shrub vegetation, and/or tree vegetation, interim revegetation potentials and final revegetation character.

Land forms --
The size, slope, orientation, shape, and character of the landforms, ridges and drainages both during the extraction phases and at completion of reclamation.

Rock outcroppings --
The size, locations, shape, slope, mass texture and overall appearance of rock outcroppings and/or rock faces.

The effects of light or seasonal changes on the significance of the subarea.

As each phase of the mining process is determined the affected areas and resulting landforms are identified, and the off-site visual appearance of the site's subareas can be evaluated. Design changes and/or operational changes can then be made to minimize the adverse visual effects seen from the community and surrounding land. These design and operational guidelines consist of such things as 1) limiting the amount of land disturbed at any one time, 2) identification of areas, landforms, vegetative character to be preserved, and/or replaced, 3) the location and design of haul roads, 4) the character and extent of areas of revegetation and rock outcropping to maintain the visual continuity of the site in relation to the Front Range vicinity, 5) revegetation and soil stabilization procedures and schedules, 6) topsoil stockpiling and redistribution, and 7) definition of areas where permanent buffering and/or screening of the operation are desirable. All of these and many other design and operational criteria are essential considerations in minimizing the potentially adverse impacts of surface mining.

Visual Impact on the Community

The visual impacts of alternative mining plans, their interim phases, and their resulting reclamation potentials can then be evaluated. This is accomplished by determining the magnitude of increased visual impact in relation to the existing conditions. The magnitude of change consists of variations in the amount of exposed land, number of people exposed to the operation, and the nature of their exposure.

The potential viewshed for each alternative is defined to establish the variations in the area exposed to the mining project. The changes in the number of people, distance and duration of exposure to the operation are then documented. The visibility, character, and orientation of the 1) land disturbed during various phases of the project, the physical extent of the mining operation, 2) the areas of revegetation and rock outcropping, 3) all aspects of the mining operation, such as the location and type of equipment and the processing and transportation of materials, and 4) the reclamation phasing schedule in relation to the extraction schedule, etc., must all then be documented to further define the magnitude of change. This information is mapped on the same base map or overlayed over the existing visual impact map to illustrate graphically those changes (fig. 4). The result is an analysis of the variations in the visual impact of a proposed mining plan and reclamation plan on the surrounding community.

The Value of Visual Analysis in Decision-making Processes

The citizen and/or government decision-maker is afforded an instrument to analyze the characteristics and results of a proposed action, and weigh them in relation to the overall policies and goals of their jurisdiction. Also, the authorities who govern mining operations can then issue permits based on an evaluation of a proposed action. This evaluation includes the short- and long-term visual implications of the mining activity. This information should be used by the client, planner, consultant, citizen and/or government decision-maker to develop detailed mining and reclamation plans which will benefit the community and its environment.

A Case Study: Death Valley National Monument California-Nevada[1]

Dan Hamson and Toni Ristau [2]

Abstract: With passage of the Mining in the Parks Act (P.L. 94-429) in 1976, the National Park Service, Department of the Interior, was given the responsibility of preparing a report to Congress outlining the environmental consequences of mining on claims within Death Valley National Monument. In addition, the Secretary of the Interior is required to formulate a recommendation to Congress on the acquisition or continued mining of claims within the monument, and on any boundary adjustment that could be undertaken to exclude mining claims and thereby reduce acquisition costs. As scenic qualities are specifically identified in the proclamation creating the monument as one of the monument's prime resources, an analysis of the visibility of mining activities by monument visitors was undertaken. The results of this analysis were incorporated in the discussion of environmental consequences and were used in the formulation of the Secretary's recommendation to Congress.

INTRODUCTION

Death Valley National Monument was established in February 1933 by Presidential proclamation under the authority of the Antiquities Act of 1906 (fig. 1). When President Hoover made the proclamation, special note was taken of the "unusual features of scenic, scientific, and educational interest therein contained . . .," and, as a result of the proclamation, lands within the monument were closed to mineral entry. However, four months after establishment of the monument, an action by Congress reopened Death Valley to mineral location

Two primary types of claims for minerals can be located under the Mining Law of 1872: placer and lode. Placer claims which may be as large as 160 acres are filed where alluvial deposits contain ore which has been carried away from its original source, usually by the action of water. Lode claims which may be approximately 21 acres are filed upon rock-in-place which contains a vein or lode, along with the adjoining surface.

In addition, the miner may claim up to 5 acres of nonmineralized land for use as a millsite. A valid or patented millsite entitles the owner to use of the surface, including such resources as water and timber, to support his mining or milling operations.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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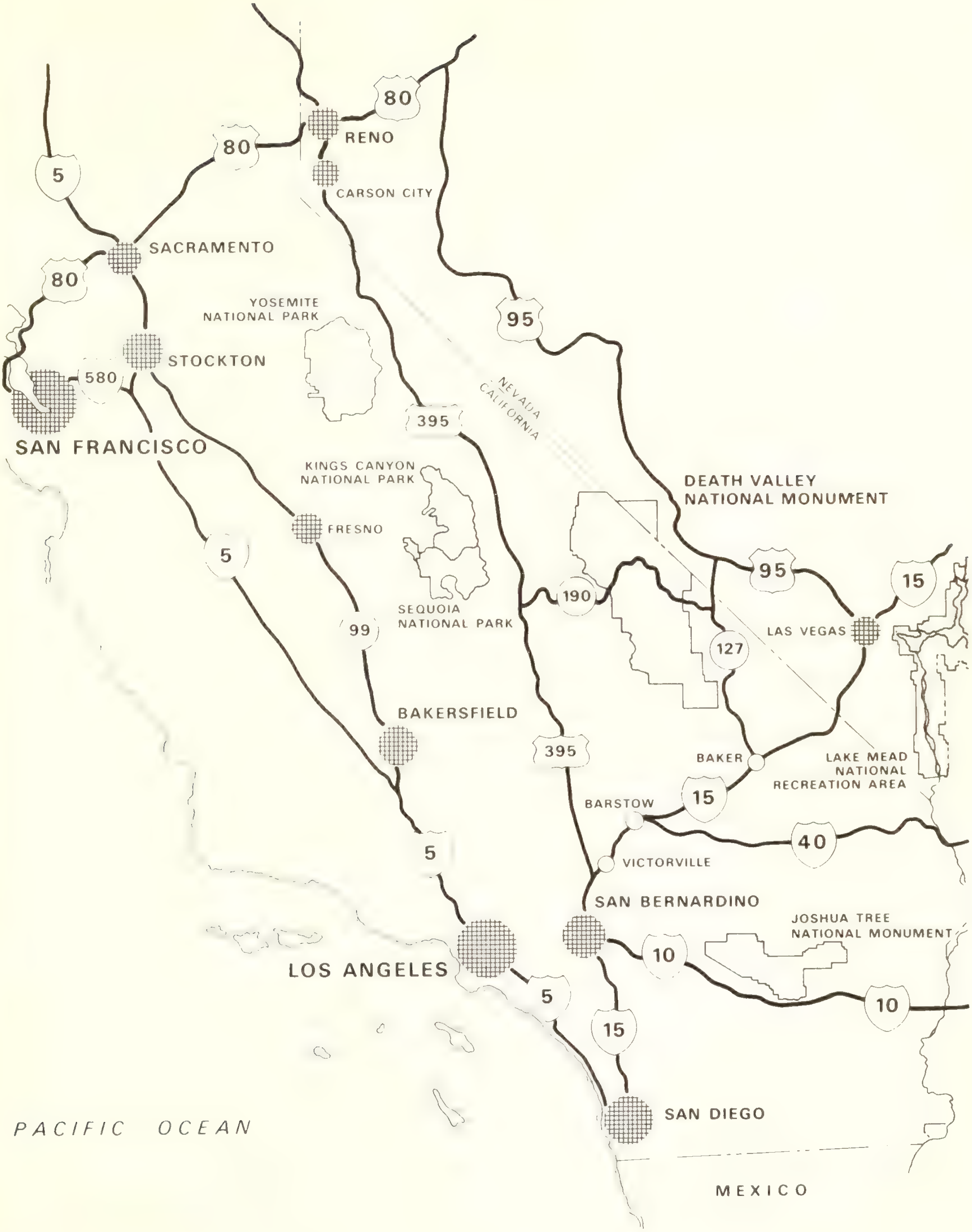

Figure 1-- VICINITY MAP
CALIFORNIA - NEVADA
DEATH VALLEY NATIONAL MONUMENT PUBLIC LAW 94 429 MINING STUDY

Death Valley has had a romanticized history of prospecting and mining. The image of the grizzled prospector moving tracklessly across the desert with his faithful burro, and the 20-mule-team borax wagon trains making the 250-mile trek to Mojave, California, are an established part of western lore. Early prospecting and mining operations were small-scale efforts; the mines themselves were underground. Despite continuing efforts to find untold mineral riches, the operations in Death Valley netted only about $2 million in the 60 years following the first flurries of prospecting activities in the 1880's. Small amounts of precious metals were discovered and mined out, but the most profitable commodities in the region proved to be talc and borates.

Talc is a relatively common mineral, and it is mined in several parts of the country (Wendel 1978). There was a brief rise in talc mining activity during World War II, but the operations since that time have been sporadic and small-scale, and remain so today. Sizeable amounts of borates within this country, however, are only found in southern California and Nevada (Wendel 1978). A few years after borates were found in Death Valley, much larger discoveries of sodium borates were made in the Searles Lake and Boron, California area, about 100 miles southwest of the monument (Cranston 1976). As a result, interest was shifted to those areas and mining for borax in the monument was essentially shut down.

In the early 1970's, increased demand for colemanite and ulexite (the sodium-calcium borate ores found in Death Valley National Monument) prompted Tenneco Oil Company to enter Death Valley National Monument and stake claims for borates directly below Zabriske Point. Internationally famous, Zabriskie Point is one of the prime scenic viewpoints within the monument; it was the view from Zabriskie Point that, over one hundred years ago, prompted pioneer William Manly to write that he had "just seen all of God's creation." After locating their claims, Tenneco announced plans to begin a strip-mining operation for borates. To the horror of both the National Park Service (NPS) and the general public, it was discovered that the company was within its rights under the Mining Law of 1872, and that the NPS could do little to prevent such an operation (fig 2). When Congress authorized mineral entry in the monument it allowed not only the prospector with burro, pick and shovel, but large-scale strip mining operations as well. The resultant public outcry prompted Congress to take steps to prevent the desecration of Death Valley National Monument's natural, cultural and scenic resource

On September 28, 1976, Congress passed the Mining in the Parks Act (Public Law 94-429). This law provided, among other things, that National Park System lands be closed to future mineral entry, that existing mineral claims be examined for validity, that the environmental consequences of mineral extraction upon these valid claims be examined, and that upon completion of these examinations the Secretary of the Interior make a recommendation to Congress on whether to: (1) allow mining to continue; (2) acquire valid claims, or; (3) exclude significant mineral deposits by boundary adjustment in order to reduce the cost of acquisition. In order to protect against additional damage to surface resources during the time allotted for the studies, a moratorium on further surface disturbance for the purposes of mineral extraction was imposed; this moratorium applied to Death Valley. The Secretary of the Interior was given until September 28, 1978 to perform the required studies and formulate his recommendation to Congress.

The NPS was given the responsibility for conducting the studies mandated by P.L. 94-429. As there was little time available in which to perform fieldwork and complete the studies, the two facets of the project--validity determination and assessment of environmental consequences--proceeded simultaneously. Originally, 860 unpatented mineral claims were recorded with the superintendent in compliance with P.L. 94-429. After completion of fieldwork, 22 of these claims were determined to be valid by the examining mining engineers, with the remaining claims being contested. Within Death Valley here are 118 patented claims in addition to the 22 valid unpatented claims. The valid and patented claims can be combined in various ways to offer a large number of alternatives which would allow mining on some claims, provide for acquisition of some claims, or exclude certain claims through boundary adjustment. It was decided, in order to facilitate the choice of reasonable alternatives, the first step would be to study the environmental consequences of mineral extraction on all of the valid and patented claims.

SCOPE OF REPORT

Because scenic quality is recognized to be one of the monument's special resource values, the impact on the landscape of the Death Valley was of major concern to the NPS. Most visitors to the monument come to view the spectacle of multicolored rock, magnificent desert vistas, stark salt pans and majestic mountain ranges. Therefore, in assessing the visual impact of mining, there was no need to conduct a landscape evaluation to define areas of the monument which were of high scenic quality, so it was

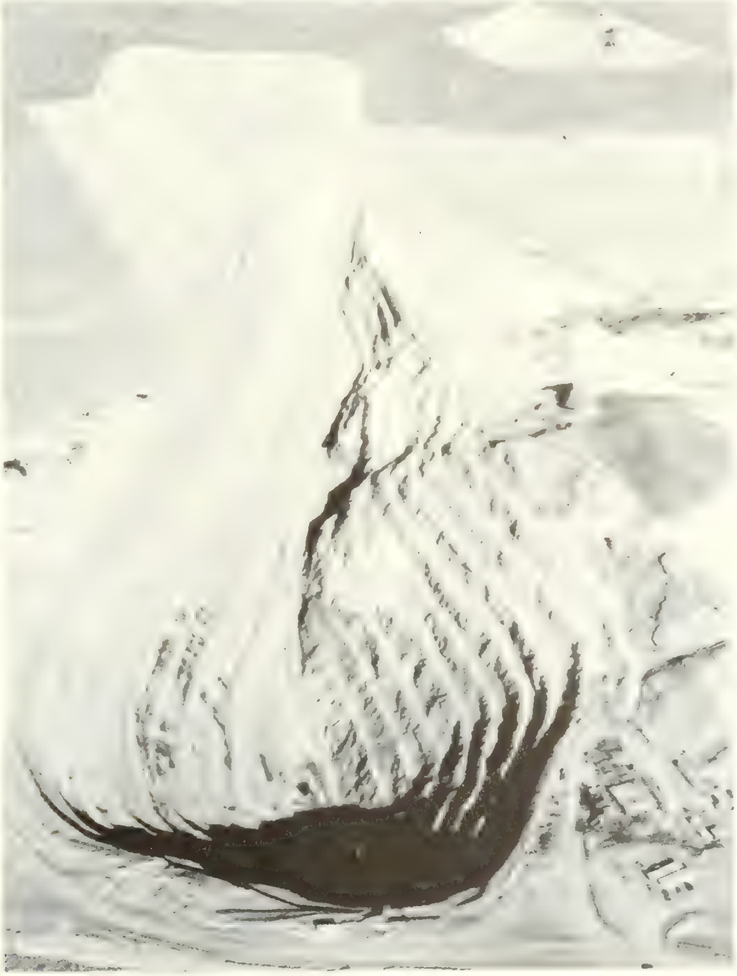

Figure 2--1975 photo showing Tenneco's Mining, Inc.'s open pit Boraxo mine located in the upper Furnace Creek Wash area of Death Valley National Monument

As a result, to define the claims with the highest visibility from sensitive visitor interest areas better, some groups were later split and run again.

Again, because of time constraints, some important factors for visibility were not included in the study (e.g., contrast, horizon silhouetting of above-ground structors, and dust/smoke plumes). Contrast, for example, was viewed by most members of the study team as extremely important. For instance, talc is starkly white and offers a high degree of contrast with the natural colors of the surrounding rock and vegetation, making talc operations slightly more visible from greater distances. However, recent reclamation programs on existing operations within the monument which mask the tailings by covering them with darker overburden materials have proven quite successful in reducing the visibility of these operations. With reclamation in consideration then, the study team chose not to evaluate contrast as a specific factor in the program. It must be emphasized that the visibility analysis was run to show which of the mining claims would be visible from visitor-interest areas. The analysis did not purport to include any information on the relative intrusiveness of differing types of mining methods or on the commodity mined, etc.

The data obtained from the computer model were plotted on monument-wide base maps, which delineate the areas within the monument from which one or more of a particular set of claims is visible. With the help of the monument staff, the most popular visitor points were identified and plotted on the base map (fig 3).

After field checking, the study team decided that the recognition factor (discussed earlier in this paper) would drop off dramatically from 20 to 25 miles from the mine area so that even if the area were visible from a great distance, the casual observer would not be able to identify a mining operation as an unnatural feature. To assist the evaluation, a circle with a 25-mile radius was drawn around each claim group analyzed and the acreage affected within that circle determined. This was then the zone of highest sensitivity, where aesthetic impact would be greater. However, in the final report, data wer presented for both zones; acreages were calculated, both within the 25-mile radius and for the entire monume as well. Finally, the number of visitor interest points and miles of monument roadway that fell within the viewshed were identified. With this information, the team was able to estimate the number of visitors who might annually view the current or potential mining operations during their visit to the monument.

CONCLUSIONS

The "visibility" analysis carrie out as one part of the overall study on the environmental consequences of mining within Death Valley National Monument was extremely valuable.[3] Selection of a computer-assisted program was necessary to conduct the analysis. Without the IMGRID-VIS program, the study team would not hav been able to conduct such an analysis manually within project time constraints and visibility would have been less completely addressed as a factor in the environmental assessment. The automated program also provided a more objective analysis by helping to remove bias so often preser in any manual analysis. Most importantly, the study team was able to quantify the impacts on the scenic and/or aesthetic resources of the monument and relate these impacts directly to numbers of visitors potentially affected. For instance, in figure 3, the mining proposed for the three claim groups would disturb a not necessary or desirable to address subjective aesthetic values. The task was simply to determine which existing or potential mining operations would likely be visible from heavily used visitor interest areas in the monument and to identify those claims where mining operations would alter the scenic quality of the monument. In carrying out this task, the parameters of "visibility" were defined to be the range in which a mine area could be recognized as such, and not just something "spotted" on the landscape. We felt this was important for an area such as Death Valley where most views are of semi-barren, multicolored rock.

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[3] The study mandated by P.L. 94-429 for Death Valley National Monument was submitted to Congress in two parts--Phase I discussed the environmental consequences of mineral extraction and included the "visibility" analysis as one factor to consider, and Phase II presented alternatives for allowing mining, boundary adjustment, and acquisition of mining claims. At this writing, Congress has not made its decision on a course of action regarding mining in Death Valley and in other National Park System units.

METHODS AND RESULTS

In order to objectively analyze the more than 2.1 million acres contained within Death Valley National Monument a computer-assisted program was imperative. In consultation with our in-house Automatic Data Processing unit, the study team decided to use a routine developed by Colorado State University which utilizes the IMGRID cellular data system developed by the Department of Landscape Architecture at Harvard University. The IMGRID system is essentially a computer program designed to manipulate natural resource data which have been organized in a grid cell structure. Visual Information System (VIS), the CSU program, is a routine of IMGRID which analyzes the terrain visible from a single point or from multiple observer points. A search of 360 degrees is made from the observer point to delineate the viewshed for a given horizontal distance.

The IMGRID-VIS program was chosen so that the terrain information already digitized by the Defense Mapping Service (DMS) and now distributed by the National Cartographic Information Center (NCIC) could be utilized. These tapes contain digitized topographic data from 1/250,000 scale U.S.G.S. topographic maps interpolated to produce a data print for approximately every 208 feet on the ground. This data interpolation is accurate within ± 100 feet vertically and ± 400 feet horizontally. Using an existing routine, the DMS data were then intergrated into the IMGRID format. Without the information available on the NCIC tapes, it would not have been possible to have the terrain information digitized and carry out the analysis within the time and budget constraints established for the project.

A study area boundary was selected to encompass the entire monument. The area contained 54,540 information cells each approximately 83 acres in size, covering an area of approximately 7,100 square miles. An elevation point was selected for each cell from information read from the NCIC tapes. To ensure that the analysis would be on the conservative side, the lowest point inside each cell was used, rather than the average or the highest. Mining claims were grouped according to specific geographic and mineral resource characteristics. This facilitated the analysis by eliminating the need to make a run from each individual mining claim (each lode claim is approximately 20 acres while each placer claim is a maximum of 160 acres). Selection of claims for grouping therefore was important since single data points were required both to represent claim groups and to fit the level of refinement mandated by the 83-acre cell size of the program.

Mining claim locations were incorporated into the program according to information furnished by the Mining Office in Death Valley. To reduce computer costs, all searches or visual scans originated from the group of mining claims and scanned an arc with a horizontal map distance of 79 miles and a vertical map distance of 82-1/2 miles. A factor of 5 feet was added to each cell searched to obtain an average height for a person standing in one location and looking into the mining area; the origin point, or mine claim, was left at ground elevation.

The tabular form was chosen for the study's final product. Thus, the value printed in any particular cell indicated the number of mining claim groups in each run which could be seen along a direct sightline from that location in the monument. If none of the claim groups was visible from a location, the cell was left blank. The program did not identify which claims within a group were visible.

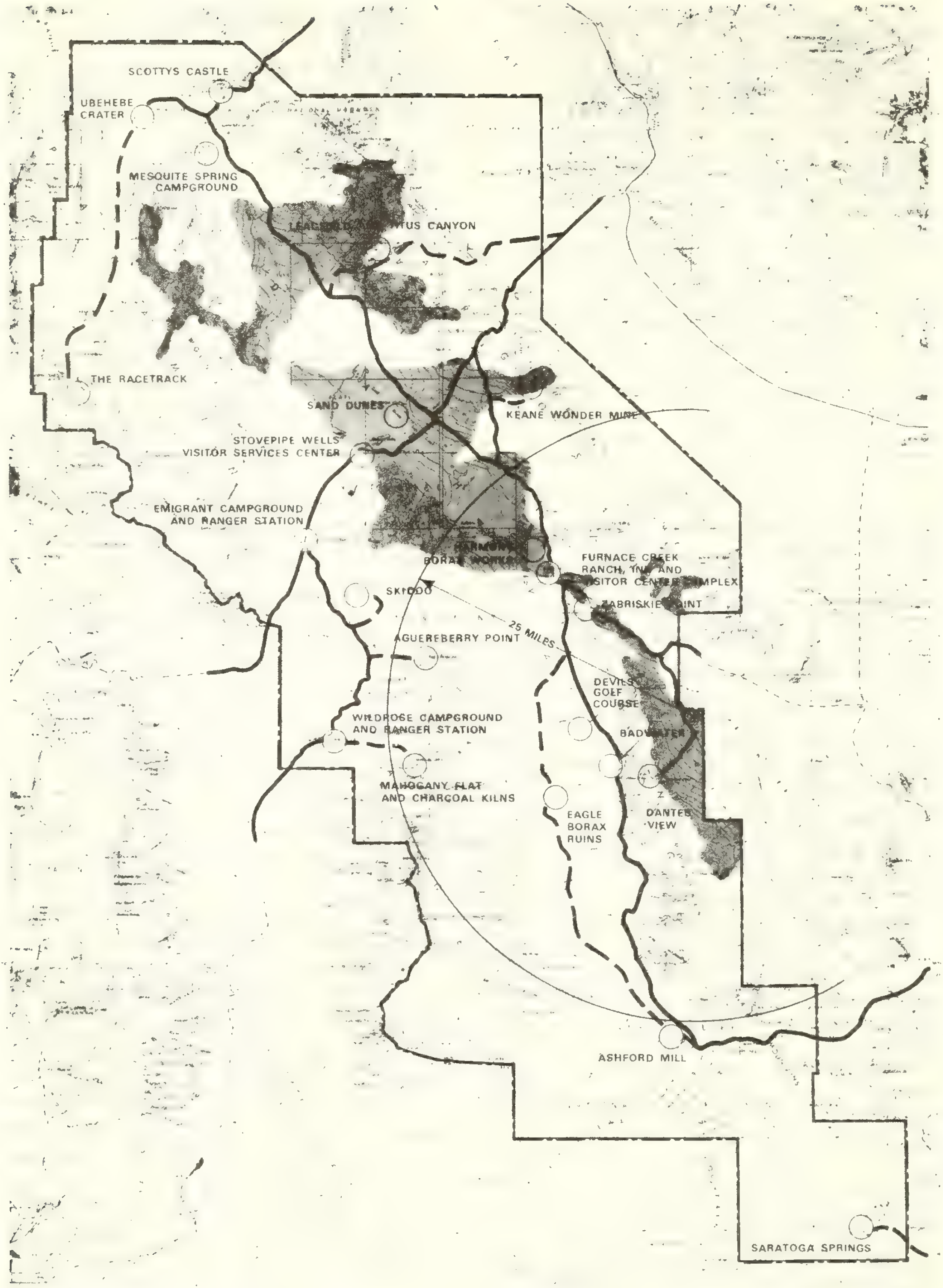
SCOTTYS CASTLE
UBEHEBE CRATER
MESQUITE SPRING CAMPGROUND
LEADFIELD, TITUS CANYON
THE RACETRACK
SAND DUNES
KEANE WONDER MINE
STOVEPIPE WELLS VISITOR SERVICES CENTER
EMIGRANT CAMPGROUND AND RANGER STATION
HARMONY BORAX WORKS
FURNACE CREEK RANCH, INN AND VISITOR CENTER COMPLEX
SKIDOO
ZABRISKIE POINT
25 MILES
AGUEREBERRY POINT
DEVILS GOLF COURSE
WILDROSE CAMPGROUND AND RANGER STATION
BADWATER
MAHOGANY FLAT AND CHARCOAL KILNS
EAGLE BORAX RUINS
DANTES VIEW
ASHFORD MILL
SARATOGA SPRINGS
PRIMARY VISITOR INTEREST POINT
MAJOR CIRCULATION NETWORK
LOCATION OF CLAIM GROUPS
AREA WITHIN THE MONUMENT FROM WHICH ONE OR MORE OF THE CLAIM GROUPS ARE VISIBLE
CLAIM GROUPS INCLUDED
5 RUSTY
35 LOUISE
46 WIDOW PAULINE

Figure 3--VISIBILITY ANALYSIS

FURNACE CREEK WASH AREA CLAIM GROUPS

DEATH VALLEY NATIONAL MONUMENT PUBLIC LAW 94 429 MINING STUDY maximum of 1,390 acres in the Furnace Creek area of the monument. However, the analysis revealed that those disturbed lands would be potentially visible from 86,000 acres within 25-miles of the claims and from 559,000 acres within the monument as a whole, potentially affecting some 310,000 visitors annually. The procedure thus allowed comparison of the visibility of mining operations on the various claim groups within the monument. The analysis has also provided help in designing reclamation plans for mining operations on claims highly visible from visitor-interest areas. Mining plans of operations developed with the goal of reducing visual impact not only reduce damage to the scenic environment but also help to reduce the cost of reclamation scheduled during operations and when mining activity ceases.

With the value, limitations and weaknesses learned during the Death Valley analysis, the NPS is again using a modified IMGRID-VIS program for a study on the consequences of open-pit mining in a historic district of Virginia. For this analysis of 14,000 acres of gently rolling terrain, the study team is digitizing its own topographic data at a greater level of definition, interpolating to within two foot contour intervals. In addition, vegetation cover, type and height is also being analyzed to evaluate the seasonal screening effect of the vegetation. With "visibility" a key controversial element in the project, the IMGRID-VIS program will allow the study team to provide a reliable, objective analysis which can directly quantify the impact of the mining on the aesthetic values of the historic district.

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Appropriate Combinations of Technology for Solving Landscape Management Problems—
Session F: Urbanization; Highway Development

Assessing the Visual Resource and Visual Development Suitability Values in Metropolitanizing Landscapes[1]

Charles B. Yuill and Spencer A. Joyner, Jr.[2]

Abstract: In response to urbanization pressures on the New England landscape, researchers at the University of Massachusetts have developed and tested two visual landscape assessment procedures as part of a comprehensive research project in landscape planning. The first procedure identifies those visually significant and unique areas within a town or region that warrant public intervention in decisions affecting their protection and preservation. The second procedure identifies the relative frequency of visual attributes within an area which enhance its liveability and hence its suitability and value for development. Both assessment procedures were constructed from research findings in the areas of scenic perception and preference, and resource econometrics. Application of the procedures seemed to show a strong corroboration between methods of scenic perception and econometric valuation techniques. The importance of relating visual values to other landscape values when making land use decisions was also demonstrated.

INTRODUCTION

If visual-scenic value is derived from the "significance that individuals place on various parts of their environment" (Zube 1974), then landscape planners, decision makers, land managers and the general public have generally recognized two distinct categories of scenic values. The first category includes those scenically unique areas whose status-quo protection provides such a public value that these areas warrant public involvement in preservation, protection, or development decisions. High slopes, natural river and stream corridors, and large diverse wetness systems when kept in public ownership may serve an entire population. But, when converted to private and unrestricted use, the benefits to be derived from such areas may be obtainable by a much smaller population.

A second category of visual-scenic values is that which enhances the quality of sites proposed for new development. For example, a forested, gently rolling hillside, providing the opportunity for distant views, is certainly more suitable for development than a flat, unvegetated parcel permitting only partial views or views of neighbors with little opportunity for screened privacy.

Our research has addressed these two categories of visual-scenic values by developing a visual resource and a visual development suitability assessment procedure. Both procedures focus on the qualitative attributes of urbanizing landscapes which seem to explain positive correlations of observer preferences for various types of landscape scenes. We selected landscape attributes and variables from the available literature which best describe major differences in visual resources and development suitability values in the region under investigation (see Craik 1971; Zube 1974; Wohwill 1968, 1978; Hendrix 1973; Kaplan 1973). In addition, attributes were selected for their evidence of applied technical utility in visual assessment techniques (Smardon 1972; Litton 1974; Forest Service 1973, 1976; Bureau of Land Management 1976; Greene 1972).

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village Nevada, April 23-25, 1979.

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It should be noted that the procedures are inferential in that they are based on interpretations of previous research supported by several assumptions and include a number of arbitrary ratings. As a partial test for procedural assumptions, a number of economic assessments were developed to correlate the perception/preference ratings with inferred monetary dollar values.

Application of the procedures utilizes a number of manual operations and computerized routines. For example, the identification of potentially unique scenic resource areas begins with a manual overlay of topography, surficial geology and land cover maps to select particular features such as drumlins wetlands and mountainous bluffs for detailed evaluation. For large areas, the computer could be used to perform this task as well. Land use, topographic quality and feature value are assessed with the aid of specialized computer programs that measure land use edge diversity, complexity and compatibility. A digital topographic data base is used for viewer position, VIEWIT view area and view potential assessments, which are part of both procedures.

The specific focus of this paper is on the visual development suitability procedure. We first will describe the step by step application of the procedure. Then we will describe its econometric dollar value estimation procedure followed by application to a town in western Massachusetts. Finally we will describe a comprehensive framework for integrating visual values with other landscape parameters such as wildlife productivity, flood hazard and development suitability construction costs.

VISUAL DEVELOPMENT SUITABILITY

As previously introduced this procedure assesses the visual attractiveness of land in terms of enhancing the land's liveability and hence its suitability for development. Three subvariables were selected for inclusion in this procedure. These are: (i) view potential. (a function of view size, site landform and land use), (ii) land use compatibility and (iii) on-site vegetation. The procedure for combining these is, in concept, simple: the ratings for each component (some of which are positive, others negative) are ultimately added together to produce the final combined rating for suitability.
large number of maps which are generated in the interim stages of the procedure and are overlaid several times, make the computerization of the whole process advisable. The principal manual tasks become the digitizing of input data and the issuing of commands to the computer to operate certain stages of the program. The steps in this technique are diagrammed in Figure 1. "View potential" is assessed in steps 1 to 3; "land use compatibility" is assessed in Step 4. These two subvariables are combined to produce a "view/setting rating" in Step 6. "On-site vegetation" is assessed in Step 5. Finally, in Step 7, all of the subvariables are considered together to derive the rating of visual development suitability.

Step-By-Step Description

Step 1 - View Area Determination. This step is the first part of the view potential assessment. It differentiates between extensive views, moderate views and limited views. VIEWIT is utilized to assess view potential from all potentially developable sites in a given area. Three ratings (0,2 and 4) are assigned to cut-offs along a continuum of view areas (0-5+ square mile view areas).

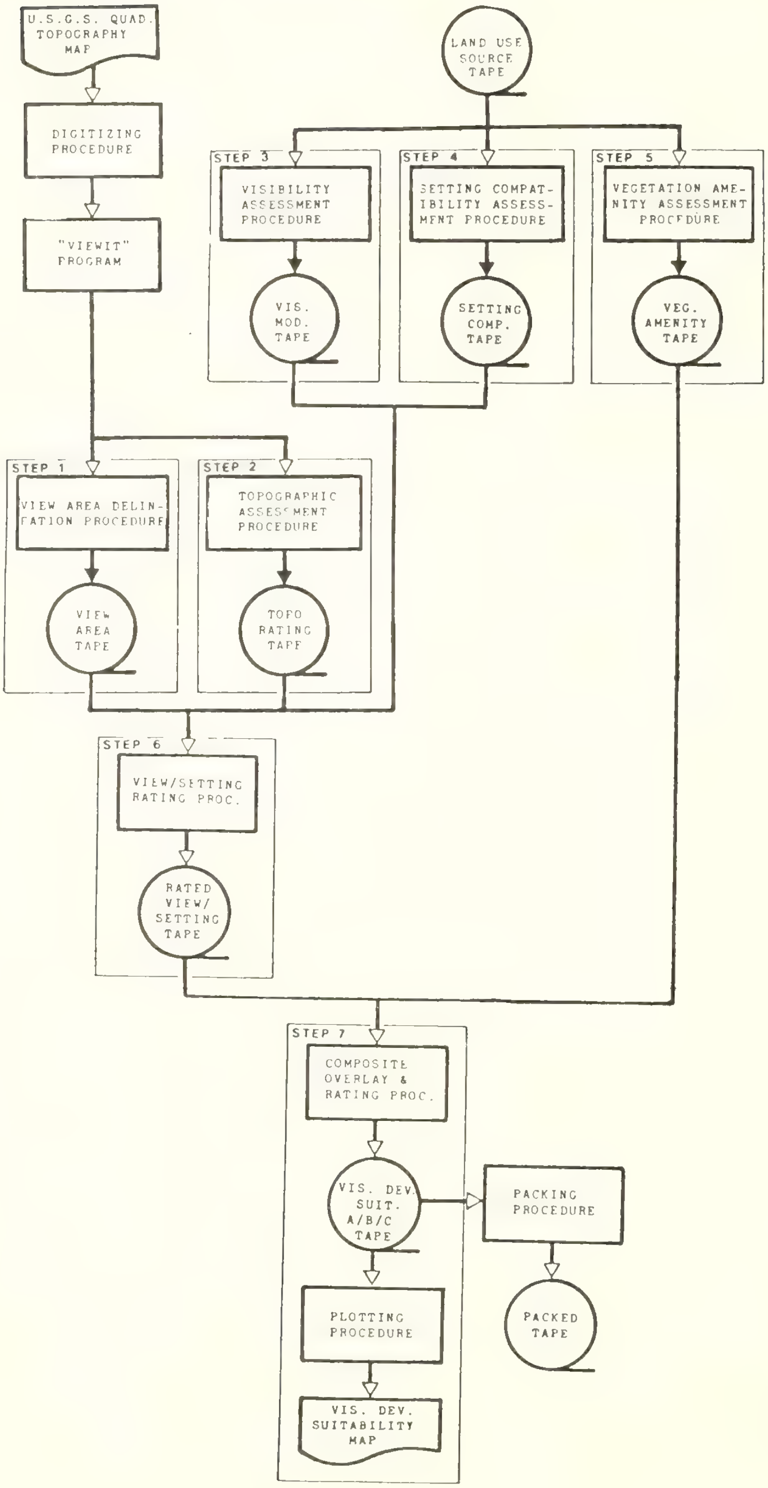
Step 2 - Topography Assessment. Topograhic position is utilized to assess both potential view obstructability and preferential value for various viewer positions. Slopes, ridges, valleys and flatlands are rated for view potential (0,1,2).

Step 3 - Visibility Assessment. This assessment takes into account the fact that the various types of surface cover (such as trees, residential and cropland) serve to limit the ability to see distant views. Land uses are analyzed for their characteristic transparency and the relative permanence of that transparency. Visibility ratings are calculated in arbitrary grid cells (generally 200-400' on each side). Land uses are assigned classes, areas summed and visibility scores (-2 to 0) are assigned to each cell.

Step 4 - Setting Compatibility. Unlike the first three steps which deal with the potential for distant views, setting compatibility addresses quality in the near view. In this procedure, land uses are aggregated into groups based on the similarity of their visual characteristics. Similar land uses are then grouped into compatibility classes; classes are assigned to the adjacencies; and compatibility scores are calculated for grid cells using the following formula.

Figure 1

Visual Development Suitability Assessment Procedure


U.S.G.S. QUAD. TOPOGRAPHY MAP
DIGITIZING PROCEDURE
"VIEWIT" PROGRAM
LAND USE SOURCE TAPE
STEP 3
VISIBILITY ASSESSMENT PROCEDURE
VIS. MOD. TAPE
STEP 4
SETTING COMPATIBILITY ASSESSMENT PROCEDURE
SETTING COMP. TAPE
STEP 5
VEGETATION AMENITY ASSESSMENT PROCEDURE
VEG. AMENITY TAPE
STEP 1
VIEW AREA DELINEATION PROCEDURE
VIEW AREA TAPE
STEP 2
TOPOGRAPHIC ASSESSMENT PROCEDURE
TOPO RATING TAPE
STEP 6
VIEW/SETTING RATING PROC.
RATED VIEW/ SETTING TAPE
STEP 7
COMPOSITE OVERLAY & RATING PROC.
VIS. DEV. SUIT. A/B/C TAPE
PACKING PROCEDURE
PACKED TAPE
PLOTTING PROCEDURE
VIS. DEV. SUITABILITY MAP

$C_q = \sum_i C_i \cdot \frac{\lambda i}{\lambda q}$

C_q = compatibility for grid cell q
C_i = compatibility for adjacency i
λi = length of adjacency i
λq = length of adjacencies in cell q

Values are modified by adjusting cell adjacency lengths up or down according to a comparison with an average edge density rating which is developed regionally to correct for the effect of land use complexity on the cell compatibility scores. Values are then assigned 0, -2 and -4 ratings.

Step 5 - Vegetation Amenity Assessment. This step assesses the visual amenity arising from on site vegetation. Land uses are aggregated into three vegetation amenity classes and assigned a +1, +2, or +3 rating.

Steps 6 and 7 - Composite Assessment. View area, topography, visibility and compatibility ratings are combined into composite view potential/setting ratings (A,B,C). The continuum of potential values (+6 to -5) is aggregated into A,B,C, letter classes and 3,2,1 numerical classes. Vegetation values are also grouped into similar letter and numeric classes.

The final rating for visual development suitability results from the combined contribution of view potential/setting and the existance of mature on-site vegetation. The 3,2,1, numeric values are combined producing a range of values from 6 to 2, which are then aggregated into A,B,C, classes to reflect values described in the following economic valuation discussion.

Economic Valuation

Introduction

Dollar values for the ratings which result from application of the visual development suitability model are derived from a study carried out with research team economists Robert Torla and John Foster. This effort utilized a housing behavior model which correlated house and site characteristics with the selling price of 205 houses in the Amherst, Massachusetts, area. "View-setting" values and "on-site vegetation" were evaluated together with thirteen other variables. View potential and on-site vegetation were measured for each of the house sites in the sample using the previously described procedures. The results of a multiple regression analysis of the 15 independent variables showed that both the "view-setting" and "onsite vegetation" variables were in fact significant contributors to the selling prices of houses in the sample.

Methodology

A model was developed which identified demand functions for various housing and environmental characteristics. The model required socio-economic data on the houses and purchasers respectively. Since socio-economic data on purchasers were not available, the study relied on implicit pricing for view, vegetation and other structural and environmental characteristics.

The implicit model was of the form:

$$P_i = F(P_H H, P_A(D)A, P_E E$$

where P_i = the price paid for the ith house
F = the functional form
P_H = vector of prices of structural characteristics
H = vector of quantities of structural characteristics
P_A = price per unit of land
D = distance from central business district
A = quantity of land
P_E = vector of prices of environmental characteristics
E = vector of environmental characteristics

(Note:)Estimation was with ordinary least squares.

Important characteristics were placed into three general classes: structural characteristics, accessibility and lot size, and environmental characteristics (i.e., flood plain location, noise level, proximity to open space, distanct view potential, etc.).

Results

After data for each characteristic were collected and coded they were analyzed with a best fit (linear) multiple regression equation to estimate an implicit pricing value associated with each structural and environmental characteristic. Table 1 presents a summary of results from application of the best fit multiple regression equation.

Data for view potential and site vegetation were then analyzed to estimate the dollar value benefits to households to be derived only from these characteristics. View potential yielded a maximum dollar value assignment of $7,600 per acre. This generally corresponded to long panoramas or vistas situated high on moderately wooded slopes with a setting containing a visual character compatible with the housing studied. The middle range appeared to extend from about $2,000 to $5,500 per acre. These views were generally impressive but less significant, and the lowest dollar value range, 0 to $2,000, extended from a complete absence of view to moderately attractive partial views.

TABLE 1

CHARACTERISTIC MULTIPLE REGRESSION RESULTS

FACTOR	ESTIMATED CO-EFFICIENT (implicit price)
Open space	3817.81 (1.35)
Noise levels	-1570.07 (1.12)
Year sold*	33.97 (0.79)
Lot size	2256.85 (4.42)
Average neighborhood lot size	-0.0297 (1.39)
Flood plain	-2887.40 (1.15)
Structure value*	1.05 (23.25)
Neighborhood condition	334.33 (0.80)
Non-conforming uses	-6.64 (0.19)
Tree density*	56.07 (2.63)
View rating*	274.30 (2.00)
Abandoned housing*	3323.21 (2.45)
Size of the house lot*	647.98 (2.24)
Size of lot/distance to town center*	616.72 (3.66)
(Square footage of lot)^2*	-12.93 (2.27)
*Significant characteristics	r^2 = ,7821

Figures in parentheses are t values, estimated coefficient is significant if t is greater than 1.65.

On-site vegetation had a maximum attributed value of $4,300 per acre. This value was for sites with mixed dense mature vegetation. On mid-range of values spanned a continuum from a few stately trees to numerous hardwoods, softwoods and mixed species, while low end values (0-$1,000) reflected sites with little amenity value because of a comple absence or a minimum of mature on-site vegetation.

Data patterns offered no logical cut of points for assigning A, B, C ratings for thre levels of aggregation. Therefore ratings wer intuitively assigned to the range of view-setting and on-site vegetation dollar values based on a visual inspection of the data. In addition, slides of all the sites studied wer examined to check the "visual-scenic" logic of those cut-off points. The A,B,C cut offs

View potential/setting (in dollars)--

A = $5,600-$7,600
B = $2,000-$5,000
C = $ 0-$2,000

Vegetation--

A = $2,700-$4,300
B = $1,000-$2,700
C = $ 0-$1,000

Visual Development Suitability--

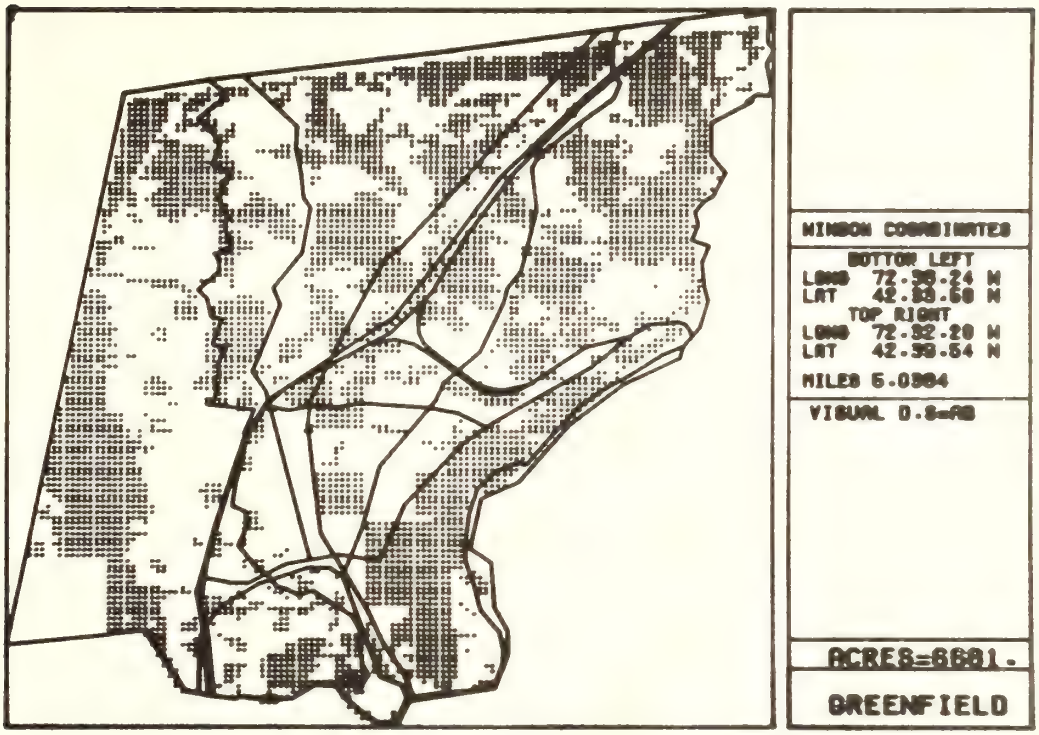
A = $6,600-$11,000
B = $3,000-$6,000
C = $ 0-$3,000

It should be noted here that similar economic valuations were developed for the visual resource procedure. In that case, however, procedures were utilized to identify implicit values to the public for status quo maintenance of visual resource areas.

Application of the Procedure

This section briefly describes application of the procedure to Greenfield, a town in the western Massachusetts study area. Figure 2 presents results of the development suitability procedure. Results reflect the diverse forest-farm-town land uses and steep hillside and stream channel dominated landforms. Areas rated C, which are approximately 50 percent of the town, include broad valleys and urbanized areas. Such areas when traditionally developed often lose their view potential by virtue of design, siting and construction of new development. A number of forested ridges and hillsides proved to offer potentially panoramic views and a mature forest cover which offer the potential for both high site and distant view amenities.

Figure 2--Visual Development Suitability Class A and B Areas in Greenfield Massachusetts



Compatibility actually proved to be the least significant dimension as the town is still lightly developed and industry free. View potential based on view area, topography, land use, and on-site vegetation was important as a significant range for these values was identified in the town.

In summary it is felt that the technique as developed represents a significant beginning in this area. It should be noted that although the extent of distant views is assessed in this procedure, the content of the views available from a site is not a factor here. It is for this reason that the view rating generated here is best considered as denoting "view potential." An effort to incorporate an assessment of the quality or character of views as a function of the land use pattern in any viewed area was made in this research, but the volume of data required for manipulation in this process proved beyond the resources of the project during this phase. However, this is an area where future refinement of this technique will probably prove fruitful. The most significant element of this research is undoubtedly the effort to corroborate the quantified measurement of visual quality, (based on professional judgments and laboratory research) with the expressed economic value of parcels of land. Not only did this effort yield an encouraging indication that the visual assessment technique developed here was headed in the right direction, it served to aid in the refinement of the aggregation of the visual development suitability classes themselves.

INCORPORATING VISUAL ASSESSMENT INTO METROPOLITAN LAND USE PLANNING

As part of the Metropolitan Landscape Planning Model (METLAND), both the visual resource and visual development suitability assessments can be readily incorporated into a much broader analysis of urbanizing areas. The ability to combine information about the visual attributes of urbanizing areas with information on valuable resources, such as prime agricultural lands, wildlife habitats, and groundwater resources; on hazards, such as flooding and landslides; and, on development suitability, may be critical to incorporating visual values into land development and protection decisions. The three following examples of how visual values could influence land use decisions in Greenfield, Massachusetts, show the importance of relating visual values to other landscape values.

Figure 3 Areas of Conflict Between Visual Resource Amenity Class A, B and C With Visual Development Suitability Class A and B in Greenfield, Massachusetts

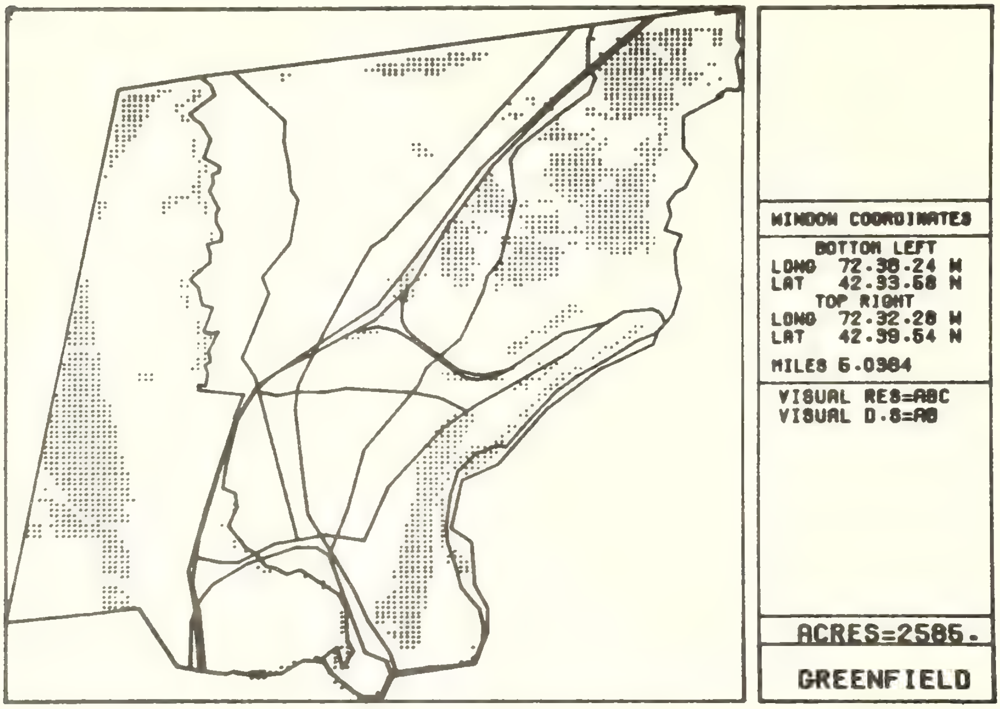


Figure 4 Areas of Conflict Between Visual Resource Amenity and Visual Development Suitability Where Residential Site Construction Costs Are High In Greenfield, Massachusetts

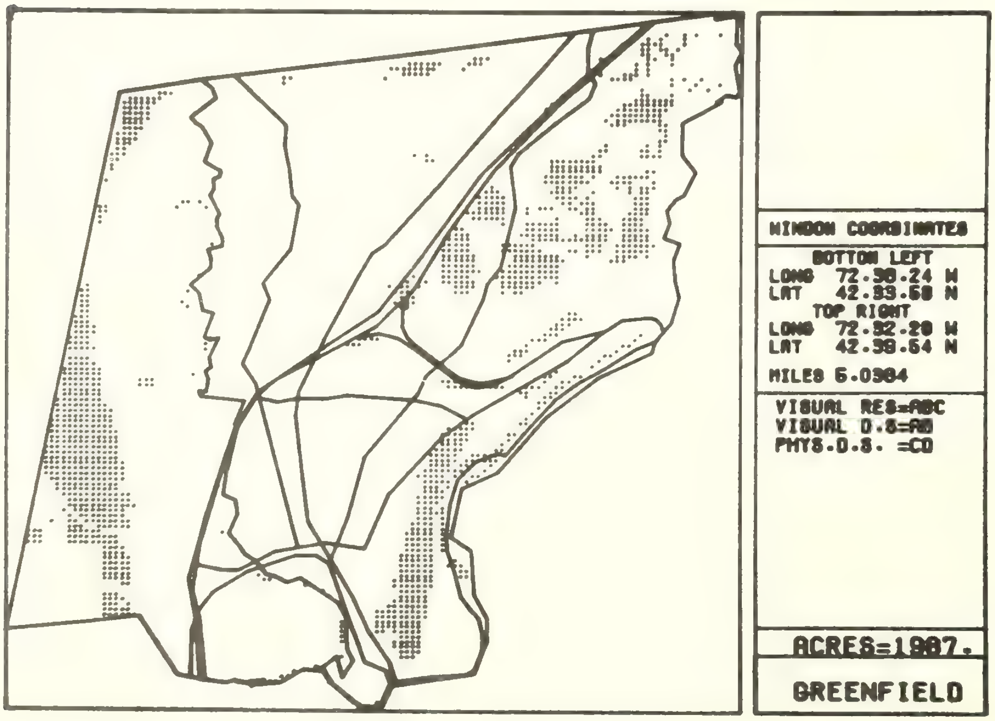


Figure 5 Areas In Greenfield, Massachusetts, Where Visual Development Suitability, Physical and Topoclimate Development Suitability, and No Flood Hazard Co-occur.

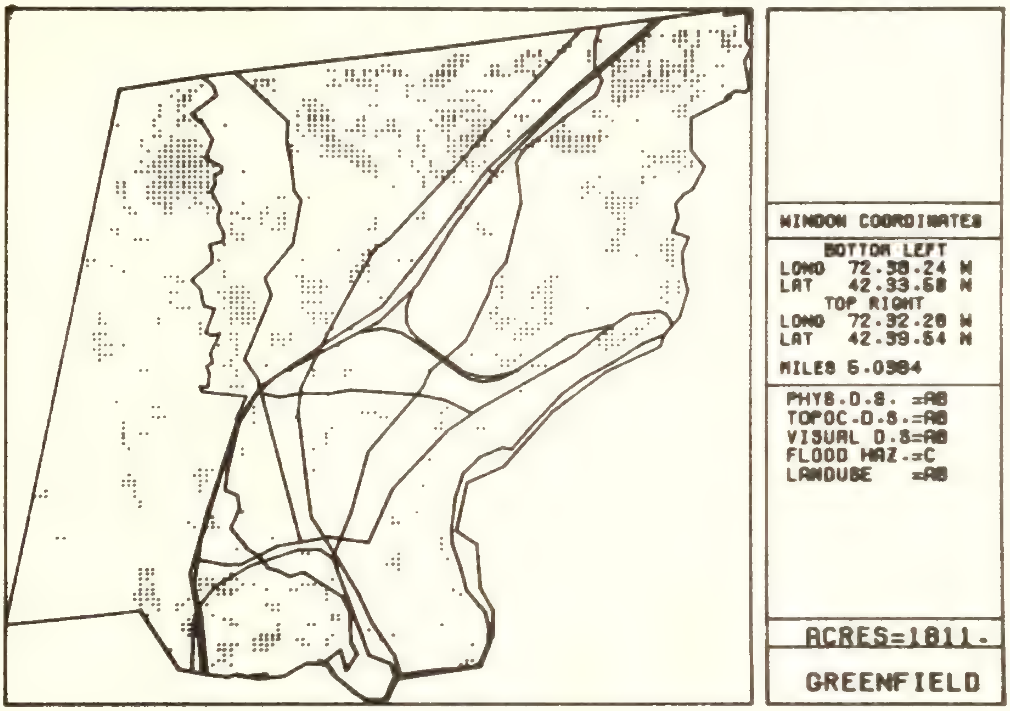
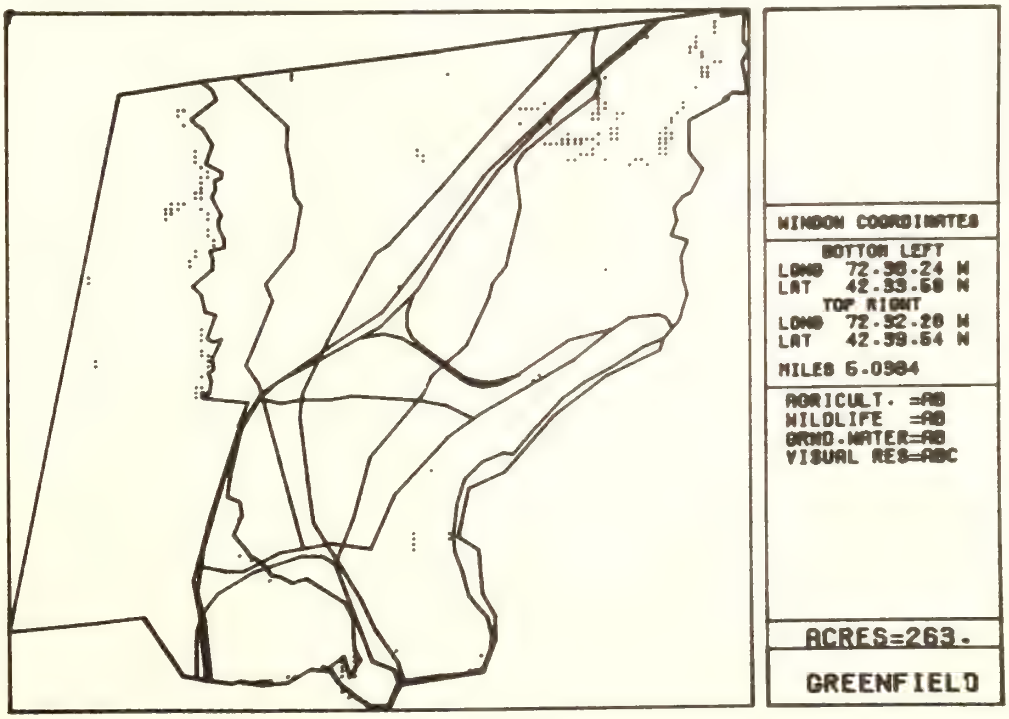


Figure 6 Areas In Greenfield, Massachusetts, Where Prime Agricultural, Wildlife, Groundwater Supply, and Visual Resource Amenity Values Co-occur.



Conflict Resolution

One of the obvious problems in need of further research is how to determine what uses are appropriate for areas possessing both visual resource amenity and visual development suitability values. This question arises in metropolitanizing landscapes as well as in wildland resort areas.

For those urbanizing landscapes possessing outstanding visual resource amenity value, implementing development controls may conflict with a developer's plan to take advantage of that area's visual development suitability value. Figure 3 shows that one sixth of Greenfield possesses areas where the conflict between visual development suitability and visual resource protection may range from \$20,000 to \$5,000 per acre for resource protection and from \$11,000 to \$3,000 for development suitability value.

One approach for selecting between those areas where development should be encouraged and those areas where visual resource values should be protected is to trade-off those areas of lesser visual resource value. (In this example-to allow development in C rated visual resource areas). A second approach might be to retain the original criteria expressed in Figure 3, while adding an additional factor such as physical development suitability (construction cost) for residential development. Figure 4 shows those areas in Greenfield where extremely poor soil and slope conditions exist for development and where visual development suitability and visual resource amenity values conflict. Since the added cost for overcoming these physical conditions exceeds their visual development suitability value it would be logical to suggest that the areas shown in Figure 4 are prime candidates for public intervention in their future use.

Improving The Visual Quality of Residential Development

The identification of areas possessing high visual development suitability value alone will not be sufficient to influence development into those areas. It may be possible, however, to connect visual development suitability values with other land development factors. Figure 5 shows those areas in Greenfield where visual development suitability values of \$11,000 to \$3,000 occur where undeveloped land also possesses good physical and topoclimate (energy conserving) development suitability characteristics and where no flood hazard exists. These areas become logical candidates for development. Further development suitability screening of candida areas using the METLAND system could include factors such as availability of municipal wat r and sewer, fire protection services, access t schools, zoning, noise pollution and other locational considerations.

Protecting Visual Resource Values

In the urbanization of the New England landscape, the problem of protecting and preserving the visual character of the region ca not be achieved by public intervention on the few truly significant landscape features. Th problem is more pervasive. How to preserve th landscape features that are highly valued is not the problem. The problem is how to protec those landscapes that possess less than truly significant values, yet actively contribute to the overall visual resource value of a community.

Perhaps it might be possible to build a coalition of interested parties to support development controls on certain landscapes that contribute to a number of different, yet mutually supporting concerns. For example, Figure 6 shows those areas in Greenfield where prime agricultural, wildlife, groundwate and visual resource amenity values occur together. The Green River corridor to the northwest and an area of mixed forest and productive agricultural land to the northeast are prime candidate areas for visual resource amenity protection that could also include arguments for prime agricultural land preservation, wildlife habitat protection, and groundwater resource protection.

In conclusion, we should remember that the visual landscape should not be viewed as a separate component of the total landscape. As visual resource managers our ultimate success in protecting those areas of visual resource quality and our success in encouragin development into those areas possessing high visual development suitability value may not be achieved through arguments based only on visual value. We should seek to link visual landscape values with other landscape values where this linking can help us achieve our visual resource management objectives.

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Measuring the Impact of Urbanization on Scenic Quality: Land Use Change in the Northeast[1]

Robert O. Brush and James F. Palmer[2]

Abstract: The changes in scenic quality resulting from urbanization are explored for a region in the Northeast. The relative contributions to scenic quality of certain landscape features are examined by developing regression models for the region and for town landscapes within that region. The models provide empirical evidence of the importance of trees for maintaining high scenic quality in areas undergoing urbanization.

INTRODUCTION

One of the most pervasive changes the world over is occurring at the fringe of urban areas where urban development is spreading onto less populated and less intensely developed land formerly in field, forest, or desert. The change in scenic quality resulting from urbanization is often negative, but may not always be so. Land use planning that considers scenic resources may serve to maintain high levels of scenic quality even in the face of intense urbanization. This paper presents the results of a study that examined the scenic resources of an urbanizing region in the Northeast, and identifies urban and natural features with strong positive and negative effects on scenic quality.

The study area comprised the portion of the Connecticut River Valley in central Massachusetts and northcentral Connecticut, and included parts of the urban fringe of Hartford, Connecticut, and Springfield, Massachusetts (fig. 1). Regression analysis was used to find relationships between (1) scenic scores of photographs of landscapes representing the study area and (2) urban and natural landscape features, such as trees, water, and buildings, that were measured on the photographs.

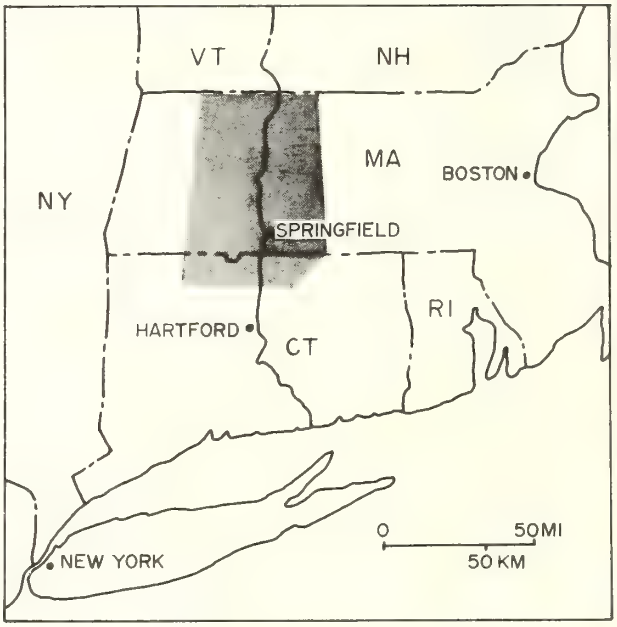

Figure 1--Study area

METHOD

Obtaining a Sample of Photographs

In an earlier study, 217 color photographs were prepared to represent various combinations of landforms and land use types found in the study area (Anderson, Zube and MacConnell 1976:8-10). All of the photographs had been taken along public roads so that they reflected the regional landscape visible to

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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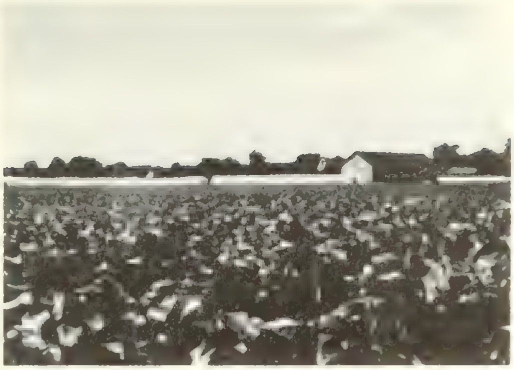

Figure 2--Farm, SRV = 6.0.

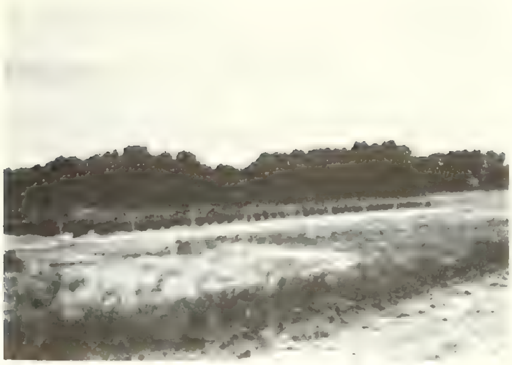

Figure 3--Farm, SRV = 3.7.

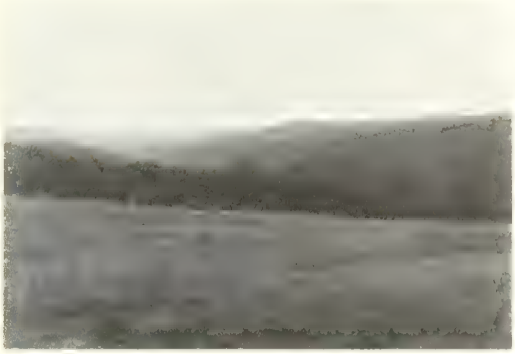

Figure 4--Meadow, SRV = 5.2.

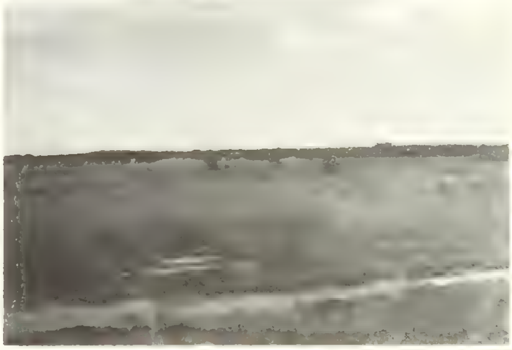

Figure 5--Meadow, SRV = 2.6.

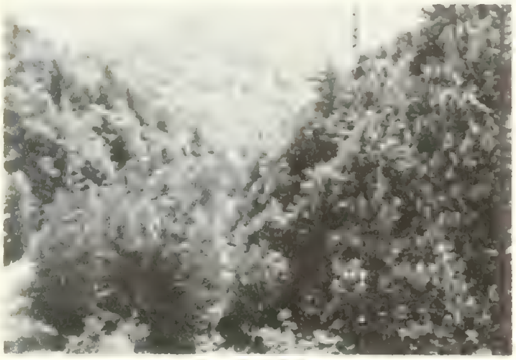

Figure 6--Forested hills, SRV = 5.4.

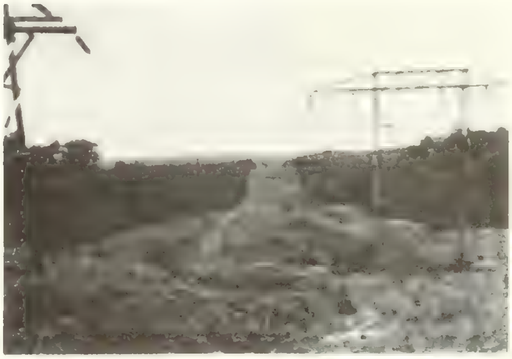

Figure 7--Forested hills, SRV = 3.1.

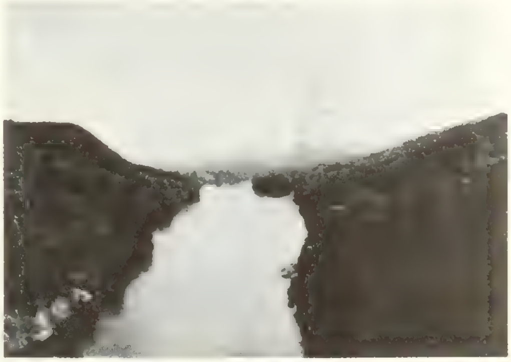

Figure 8--Open water, SRV = 6.5.

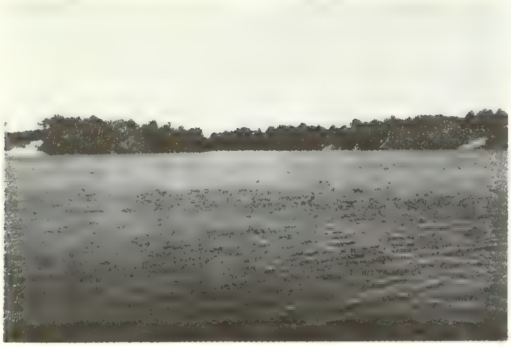

Figure 9--Open water, SRV = 4.4.

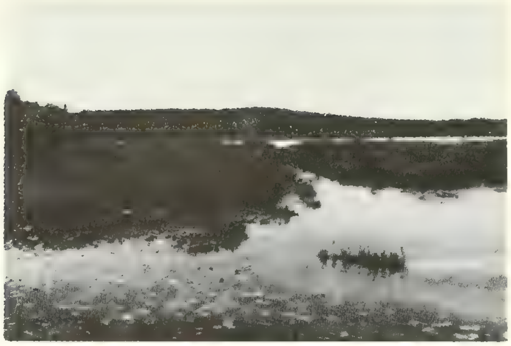

Figure 10--Wetland, SRV = 5.7.

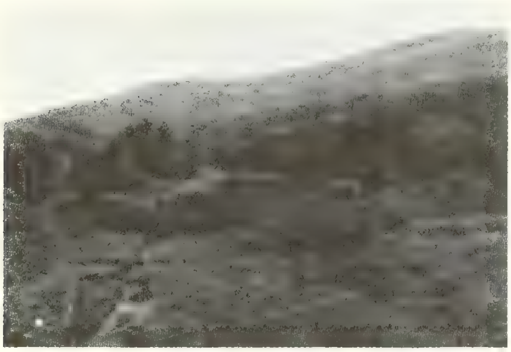

Figure 11--Wetland, SRV = 5.0.

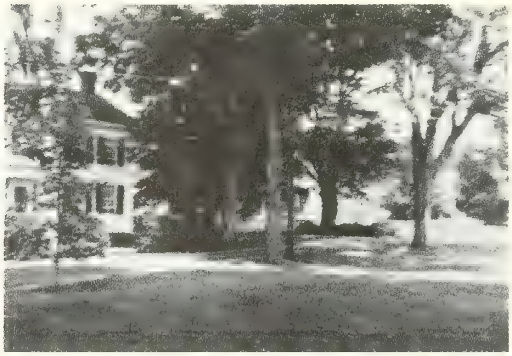

Figure 12--Town, SRV = 5.3.

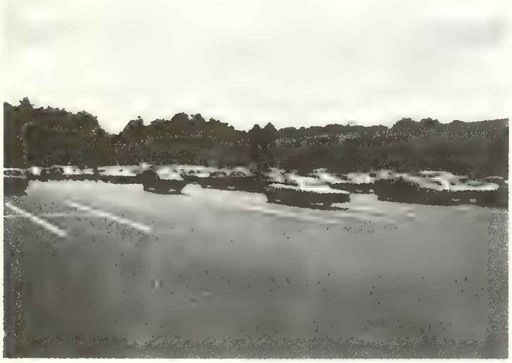

Figure 13--Town, SRV = 1.2.

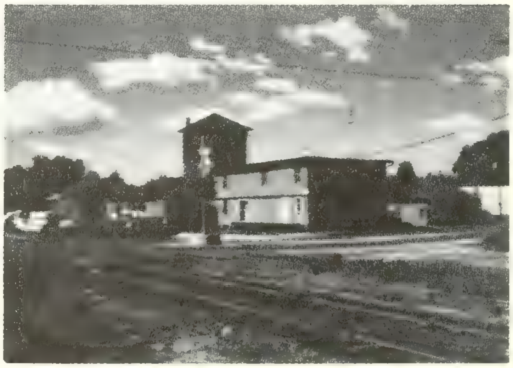

Figure 14--Industry, SRV = 4.0.

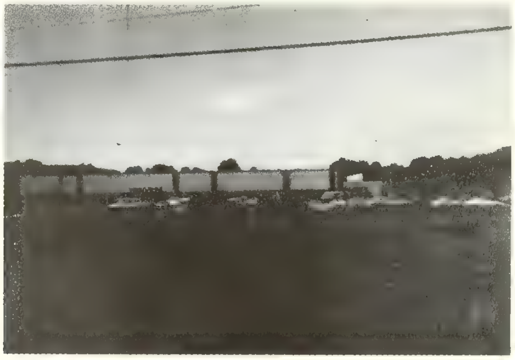

Figure 15--Industry, SRV = 1.9.

residents and travelers in the region. No attempt was made to frame the scenes with foreground vegetation or other foreground elements. Although the photographs were not composed for artistic merit, we found them to be characterized by an openness at the center of the view allowing the observer to see over the foreground and middleground. The space at the center of the scenes was usually enclosed by high landscape features in the background--hills, trees or buildings. Thus, what we term landscapes are not random views from a roadside, but instead are views of broad, enclosed spaces extending some distance away from the observer.

Because photographs can distort or misrepresent actual conditions, it is usually advisable to compare responses of people to photographed scenes with responses of people standing at the same site from which the photographs were taken. In this case we relied upon tests conducted in a previous study which found that similar responses were obtained for groups rating the photographs and groups rating the same scenes on-site (Zube, Pitt, and Anderson 1974:49).

All of the 217 photographs in this large sample had been evaluated on scenic resource value by a group of 30 landscape architects and planners employed by universities, public agencies, or private offices within the study area (Anderson, Zube, and MacConnell 1976:7). Using the Q-sort procedure, each respondent sorted the 217 photographs into seven groups of fixed size approximating a normal distribution. Each class was assigned a value ranging from 1, for lowest scenic quality, to 7, for highest scenic quality. The scores for each photograph were averaged, and we refer to the average score of a photograph as its scenic resource value.

In addition, each of the photographs had been classified in one of seven landscape classes following principles of numerical taxonomy (Palmer 1978). All of the 18 persons making the classifications were residents of the study area. The seven landscape classes included farms, forested hills, meadows, open water, wetlands and streams, towns and industry.

For this study we selected a sample of 124 photographs from the larger sample of 217. All 77 of the photographs in the larger sample, classified as either town or industry landscape classes, were used for this study. Another 47 photographs were selected at random from the remaining natural landscape classes--farm, forested hills, meadow, wetland and open water (figs. 2-15).

Scenic resource values ranged from a low of 1.2 to a high of 6.5. The widest range in values was among the scenes classified as town landscapes. Most of the town scenes, however, had scenic resource values well below the overall mean of 3.6, as did all of the industrial landscape scenes. The scenic resource values of farm, wetland and open water landscapes were above the mean value, as were most of the forest and meadow landscapes (fig. 16).

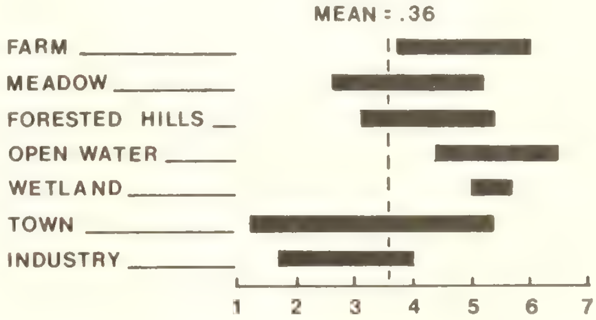

Figure 16--Scenic resource value by landscape class

Measuring Dependent Variables on the Photographs

One of the advantages of using photographs to study how people perceive scenic quality is the ability to control what the respondents are viewing. Since the scenic quality ratings are based on information contained in the photograph, various landscape features were measured directly from the photographs. These landscape features became the independent variables in a regression model.

Shafer, Hamilton and Schmidt (1969) found that combinations of landscape features in three distance zones, measured directly from photographs, explained 65 percent of the variation in scenic scores for a sample of 100 natural and wildland scenes in the United States. A similar procedure was followed in this study. Three distance zones were established: a near zone within which individual leaves of trees could be discerned; a middle zone in which the forms of trees could be discerned; and a far zone in which the shapes of trees could not be discerned. The area on the photograph of various landscape features within each of the three distance zones was measured with a planimeter in square inches.

The natural features measured were the area of trees, exposed ground and low vegetation (grass, meadow or pasture) in each of the three distance zones; the area of water over all distance zones; and the area of sky. The urban features measured were the area of buildings in each of three distance zones; the area of signs in near and middle zones, and the area of paving and signs over all distance zones. In addition, the length of wire between utility poles was measured in inches, and the number of utility poles in view was recorded.

Analysis

We developed two models by regressing the scenic resource value of a photograph on the quantity of landscape features measured on the photographs. The regional landscape model was based on 124 photographs of seven landscape classes in the portion of the Connecticut River Valley under study. The other model was based on 67 of the town landscapes from the larger sample.

Before running the model we checked for high correlation between independent variables and found none of the pairwise correlations to be excessive, that is, over 0.7.

We avoided a possible problem of multicollinearity by dropping the area measure of sky from the entire sample. Since the sum of the area variables measured in a photograph equaled a constant value, the last area variable entering the model could have been highly correlated with the sum of the other area variables.

The regional model accounted for 63 percent of the variation in scenic resource value. In order to determine how much variation was explained by distance zones alone, we ran a regression on the same landscape feature summed across the three distance zones. Without the distance zones, the model accounted for 53 percent of the variation in scenic resource value among the 124 photographs, or 10 percent less. The same 18 variables in the town landscape model accounted for 68 percent of the variation in scenic resource value.

The standardized regression coefficients for the regional model of all landscape classes in the study area appear in Table 1. Seven variables had a significant and positive effect on scenic resource value in all landscape classes throughout the region--trees in all three zones, low vegetation in the near and far zones, water surface area and buildings in the far zone. Three variables had a significant and negative effect--length of utility wires, utility poles and exposed ground in the far zone.

The large sample of town landscapes (n = 67) and the wide range of scenic resource values (1.17 to 5.40) allowed us to run a separate regression model to study the relative contribution to scenic quality of natural and urban landscape features in a town setting. Of the 18 measured variables, 6 were significant with positive signs--trees in the middle and far zones, low vegetation in the near and middle zones, exposed rock or ground in the far zone and buildings in the middle zone.

Table 1 also lists the percentage of the photo sample in which a variable was measured. None of the variables covered more than 60 percent of any photograph.

DISCUSSION

Looking more closely at each model, we find that the standardized regression coefficients reveal the relative effect of particular landscape features on scenic resource value, holding all other variables constant. The advantage of reporting standardized regression coefficients is that they are independent of the scales used to measure the variables. If one coefficient is twice as large as another, then that variable is approximately twice as important in explaining scenic resource value. The real value of models such as these is in the insights they provide about the relative contribution of certain landscape features to scenic scores. In the regional model we find that natural landscape features have a positive effect on scenic resource value, and that most urban features have a negative effect.

The variables that best explain the model are those that are statistically significant. We selected 0.05 as the level of probability for significance. In the regional model there were nine significant variables. Trees, in all three distance zones, and water had large positive coefficients. Low vegetation in the distant zone had a large positive coefficient. The area of buildings in the distant zone also had a positive coefficient. Therefore, photographs containing large amounts of these variables will have high scenic scores. Utility poles in the regional model had a high negative coefficient; exposed ground in the middle zone and wire also had negative coefficients. Photographs containing large amounts of these landscape features are likely to have low scenic resource value.

Table 1--Standardized regression coefficients and frequency of photo-measured variables.

Landscape feature	Distance zone	Regional landscape model		Town landscape model	
		Standardized regression coefficient	Percent frequency in photo sample (n = 124)	Standardized regression coefficient	Percent frequency in photo sample (n = 67)
Trees	Near	.23*	26	$.19^{ns}$	25
	Middle	.37*	76	.93*	91
	Far	.26*	85	.33*	76
Low vegetation (grass, meadow pasture)	Near	$.18^{ns}$	25	.35*	22
	Middle	$.17^{ns}$	83	.69*	88
	Far	.14*	11	$.04^{ns}$	4
Water	All	.37*	16	$-.15^{ns}$	1
Exposed rock or soil	Near	$.09^{ns}$	12	$.06^{ns}$	12
	Middle	-.17*	64	$.05^{ns}$	78
	Far	$.07^{ns}$	12	.27*	9
Building	Near	$.01^{ns}$	2	$.17^{ns}$	4
	Middle	$.09^{ns}$	62	.47*	92
	Far	.19*	27	$.13^{ns}$	28
Paving	All	$-.08^{ns}$	64	$.36^{ns}$	94
Wire	All	-.15*	44	$-.08^{ns}$	60
Utility poles	All	-.27*	65	$-.04^{ns}$	85
Signs	Near	$-.04^{ns}$	2	$-.04^{ns}$	3
	Middle	$-.03^{ns}$	30	.00	49

ns = not significant
* = $P < 0.05$

In the town landscape model there were six significant variables, all with positive coefficients: trees in the middle and far zones, low vegetation in the near and middle zones, exposed ground in the far zone and buildings in the middle zone.

By far the most influential variable in the town model was trees in the middle zone with a coefficient of 0.93. It is not clear what it is about trees that explains their strong positive effect on scenic quality in town landscapes. Perhaps the tall vertical masses of foliage rising above houses screen out utility poles, paving and buildings that lie beyond. Perhaps the trees symbolize the pastoral landscapes that suburbanites are seeking. Whatever the reason, the effect of trees is positive and pronounced in town landscapes.

The positive effect of buildings in the middle zone of town landscapes is an interesting one. Even the correlation coefficient of middle zone buildings and scenic resource value was slightly positive. This may reflect the influence of old and substantial homes in some of the photographs, or it may mean that buildings, primarily residences, are accepted features of town landscapes.

The regional and town landscape models were not meant to be used to predict scenic quality. The models were developed to study the relationship of certain landscape features to scenic quality. The findings of this research lend support to the belief that trees are an important scenic resource, particularly in areas undergoing urbanization.

In reviewing the process by which land is converted to suburbs in this country, Clawson (1971:50) noted that urban uses nearly always dominate over agricultural uses, and almost always dominate over forestry and grazing uses. Although the process of suburbanization of land may be inevitable, deterioration of scenic quality may not necessarily follow.

From our study in the Northeast we find that the presence of trees in town landscapes is the single most important landscape feature affecting scenic resource value. To the extent that trees and woodlands are retained during suburban land development, and to the extent that street trees are planted and open space is reserved, the scenic quality of town landscapes can remain high, as high as it might have been before as farmland or wildland.

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A Comprehensive Approach to Visual Resource Management for Highway Agencies[1]

William G. E. Blair[2/], Larry Isaacson[3/], and Grant R. Jones[4/]

Abstract: To help ensure that visual effects are considered at all stages of highway agency decision-making, the Federal Highway Administration contracted with Jones & Jones to develop and conduct a five-day training course to guide highway professionals in developing VRM processes for their own agencies.

The training course emphasizes overall principles, the need for a comprehensive approach that deals with all the elements of visual management problems, and the ability to tailor the level of VRM effort to the needs of a specific project. The concept of the VRM objective links assessment to management. The VRM objective is a tool for defining visual management problems and evaluating the effectiveness of alternative solutions. Several examples are included in this paper.

INTRODUCTION

Need And Context

Most major roads are part of the ederal-aid Highway System. As the phrase mplies, the primary source of capital funds or these highways is the federal government, ut the direct responsibility for planning, esign, construction and maintenance rests ith the states. The Federal Highway dministration (FHWA) has funding and review esponsibilities for Federal-aid highways at various points in the highway development process.

FHWA relies heavily on research and technical assistance to help the state highway agencies (SHA's) continue to improve their transportation product, comply with federal environmental legislation, and reach highway decisions that are appropriate, feasible, timely and -- absolutely essential to implementation -- acceptable to the general public. An extensive training program is administered by the National Highway Institute (NHI) as part of the FHWA technical assistance effort.

FHWA has long recognized the importance of highway esthetics in its research program (Hornback and Okerlund 1976). The Office of Environmental Policy recognized the need to follow through on the research and further assist the states by illustrating how visual considerations can be included in highway agency decision-making. In 1976, the Office decided to offer a five-day course on

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/ Presented at the National Conference on Applied echniques for Analysis and Management of the isual Resource, Incline Village, Nevada, pril 23-25, 1979.

/ Principal, Jones & Jones, Seattle, Washington.

/ Chief, Environmental Quality Branch, Office f Environmental Planning, Federal Highway dministration, Washington, D.C.

/ Partner, Jones & Jones, Seattle, Washington.

"Esthetics and Visual Resource Management for Highways" through NHI to guide highway professionals in developing and implementing explicit Visual Resource Management (VRM) processes for their own agencies.

Training Course

The Federal Highway Administration contracted with Jones & Jones, a Seattle planning and design firm, to develop and conduct the training course. R. Burton Litton, Jr. assisted with concepts and critiques during the development phase, and Toner & Associates contributed their knowledge of training techniques and community involvement processes. In an unusual turnabout, Jones & Jones retained the Washington State Department of Transportation as subconsultants. The help of the Department's landscape architects, engineers and librarians was an invaluable guarantee that the course approach would tally with state highway agency needs and that the course techniques could be applied immediately to actual projects.

To accompany other group training materials, the consulting team produced a workbook (Jones & Jones 1978) which includes principles, processes, techniques and exercises, a comparative glossary and extensive references. To date, some 300 administrators and staff professionals from state and federal agencies have participated in the course. The course has been enthusiatically received.

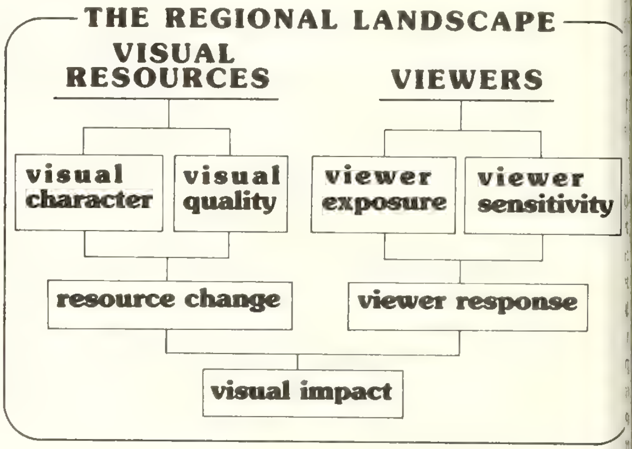
The course is intended to help participants integrate visual resource considerations into their own agency decision-making systems. For this reason, the course emphasizes overall principles as well as illustrating specific techniques which can be (and are) applied immediately to actual projects by participants. It stresses the need for a comprehensive process of visual resource assessment and evaluation that can provide the factual groundwork for later management deliberations. This process must deal with all the elements of visual management problems from systems planning through project maintenance.

The course also stresses the need for flexibility, i.e., the ability to tailor the level of VRM effort on any specific project to the needs of that project. Because of the needs for flexibility, ease of communication, and detailed consideration of project alternatives, the course primarily utilizes descriptive approaches to visual resource assessment. However, computer-assisted and psychometric approaches can also be effectively employed.

ASSESSMENT PROCESS

The general organization of the assessmen process is illustrated in figure 1. The majo components to be assessed are the regional landscape in which a project is to be constructed, the visual resources of the site, and the viewers who will be affected by the visual impact of the project. In the assessment process, equality of consideration is implied between viewers and visual resources. Relative importance varies from project to project and can only be determined by the results of the assessment process or an abbreviated version of it -- a "scoping study.

Figure 1--Visual resource assessment process.



This assessment process is similar in outline to the VRM systems employed by several major federal agencies. The similarity is deliberate, because many SHA's have to respon to the requirements of these agencies, particularly in the West.

Regional Landscape

The entire assessment process is encircled by the regional landscape to emphasi the importance of identifying the visual conte of both state-wide programs and individual projects. The starting point of landscape classification is identification of the region landscape components: its landform and land-cover (water, vegetation and manmade development). Characteristic combinations of these components are termed landscape types and recu hroughout a landscape region. A landscape ype is visually homogeneous and is usually nly one of several types visible in a given andscape unit. Unlike a landscape type, a andscape unit is a visually distinct combinaion of landscape components with a "sense of lace" -- frequently based on spatial enclosure. he visual resources of landscape units can be ompared and assigned management priorities ithin the context of the regional landscape.

Visual Resources

Once the landscape setting has been laced in its regional context, the next step n the assessment process is the assessment f the setting's visual resources.

Visual character is seen in terms of patrn elements (e.g., form, line, color, texture) d the pattern relationship between these elents (e.g., dominance, scale, diversity, connuity). Assessments of visual character are scriptive (Viohl 1976) and utilize concepts adily understood by persons inside or outside e design professions. It is therefore relavely easy to train persons in their use and obtain consistent, predictable results raik 1972).

If explicit and well-defined criteria re used, evaluative appraisals of specific spects of visual quality in the landscape an be objective in the sense that "reliable" esults are obtainable from different observers. uch appraisals can also predict judgments of isual quality by the general public if approriate criteria are used. This predictive apability is another test of objectivity: valuative criteria are "valid" if they easure factors related to general public udgments of visual quality.

Three evaluative criteria are introduced nd applied in the training course: vividness, ntactness and unity (Burnham et al. 1974). These riteria are largely independent. For example ne landscape may be vivid because of a billoard, while having low visual unity and quality. nother more natural landscape may be visually ntact, exhibit a high degree of visual unity nd yet lack vividness and therefore attain only oderate visual quality. The challenge to the ighway professional is to achieve project-andscape relationships that exhibit all three haracteristics in a moderate-to-high degree.

After assessment of existing conditions (visual quality, visual character and visual information), the next step in the process is measuring the resource change that will be introduced by the project. Changes in visual quality and visual character can only be accurately evaluated if careful simulations of a project are prepared from viewpoints representative of the locations from which the project will generally be seen.

Viewers

The other half of the assessment process outlined in figure 1 concerns the viewers. Several viewer issues are subsumed under viewer exposure. These include mapping a project's viewshed and identifying viewer numbers, viewer location and view duration, all of which can be resolved on the basis of visibility analysis and are well-suited to computer-assisted approaches such as VIEWIT (Travis and Elsner 1975).

Issues related to viewer concern for visual amenity are subsumed under viewer sensitivity. The level of viewer concern can vary significantly, depending upon viewer activity, local values and the broader cultural significance of specific visual resources. These issues can be addressed by combining the tools of the social scientist and the design professional. Psychometric approaches can be very useful; visual considerations should also be included in an agency's community involvement program. The program can then identify project issues, community preferences, specific valued resources, levels of concern and the degree to which expressed concerns are shared in the community.

Measuring viewer response to a projected resource change is essential in determining the acceptability of a project. Measures of response include the physical measures of visibility and viewer exposure and the social measures of viewer sensitivity discussed above. Simulations of project appearance are excellent tools for eliciting viewer response in community involvement programs. If the simulations are accurate and representative of actual viewing conditions, they can also help to dispel project opposition when it is based on exaggerated fears over project appearance.

Visual Impact

An adequate visual impact assessment must examine both the resource change introduced by a program or project and the viewer response to that change. Using community workshop techniques, it is possible to combine all the elements of visual impact into a single numerical rating. Whether this is an effective approach remains an open question. It may often be more useful to narrow the range of factors under final consideration to those that demonstrate significant differences among alternatives.

A documented visual assessment is often required for major projects at the EIS stage. VRM documentation can be useful at other stages, too, because of the long time periods inherent in the highway development process and the lack of staff continuity inherent in the organization of SHA's along functional lines. The staff for the next project stage needs to know the project context, visual issues and VRM decisions for effective follow-through.

MANAGEMENT PROCESS

Approach

The visual resource assessment process develops an information base. The next step is to use this assessment information to help make decisions about managing visual resources, from systems planning through maintenance.

Figure 2--Visual resource management process.

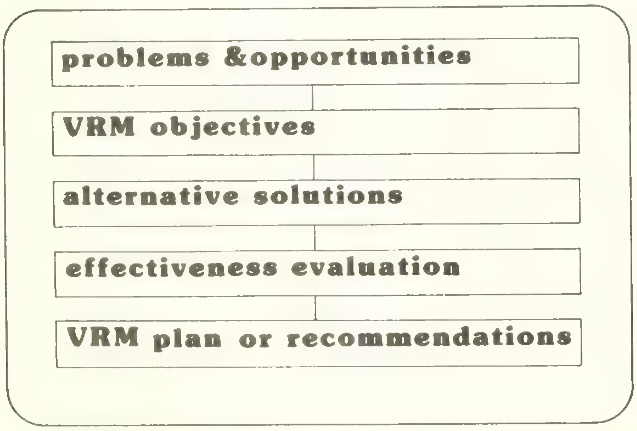


Figure 2 presents the management process in outline. The first step, identifying and prioritizing problems and opportunities, flows directly from the visual assessment process. In the next step an important concept, the VRM objective, links assessment to management. The VRM objective is a tool for defining visual management problems and evaluating the effectiveness of alternative solutions to those problems. Based upon an explicit evaluation of effectiveness, a VRM plan or set of recommendations can be prepared for interdisciplinary consideration within other project issues.

VRM Objectives

"Management by objective" is widely used in government and industry, and is extremely useful for integrating VRM with other aspects of management. A VRM objective must specify the visual resources and viewer groups to be affected, the results to be achieved, the time for achievement and the measures by which achievement is to be evaluated.

The syntax for writing a VRM objective can be reduced to this formula: Environmental Management Principle + Assessment of Effect + Visual Resources + Viewer Groups. In essence it is a visual "performance specification;" the key to the evaluation of alternative solutions is the appropriate assessment of effect. Environmental management principles are imperative verbs, such as "enhance" or "mitigate" that specify levels of achievement in relation to levels existing before the project or program.

VRM objectives can be as broad or as detailed as desired. As visual resources, viewer groups and assessment of effect become more specific, the ambiguity decreases and the likelihood of appropriate VRM treatment increases. For example, consider these two VRM objectives: "Enhance the views of major landmarks for drivers on the freeway;" "Enhance the duration of views of major downtown landmarks for northbound drivers on SR 509." It should be noted that a VRM objective need not be limited to visual character or quality issues, but can address any resource or viewer concern.

APPLICATION

Project

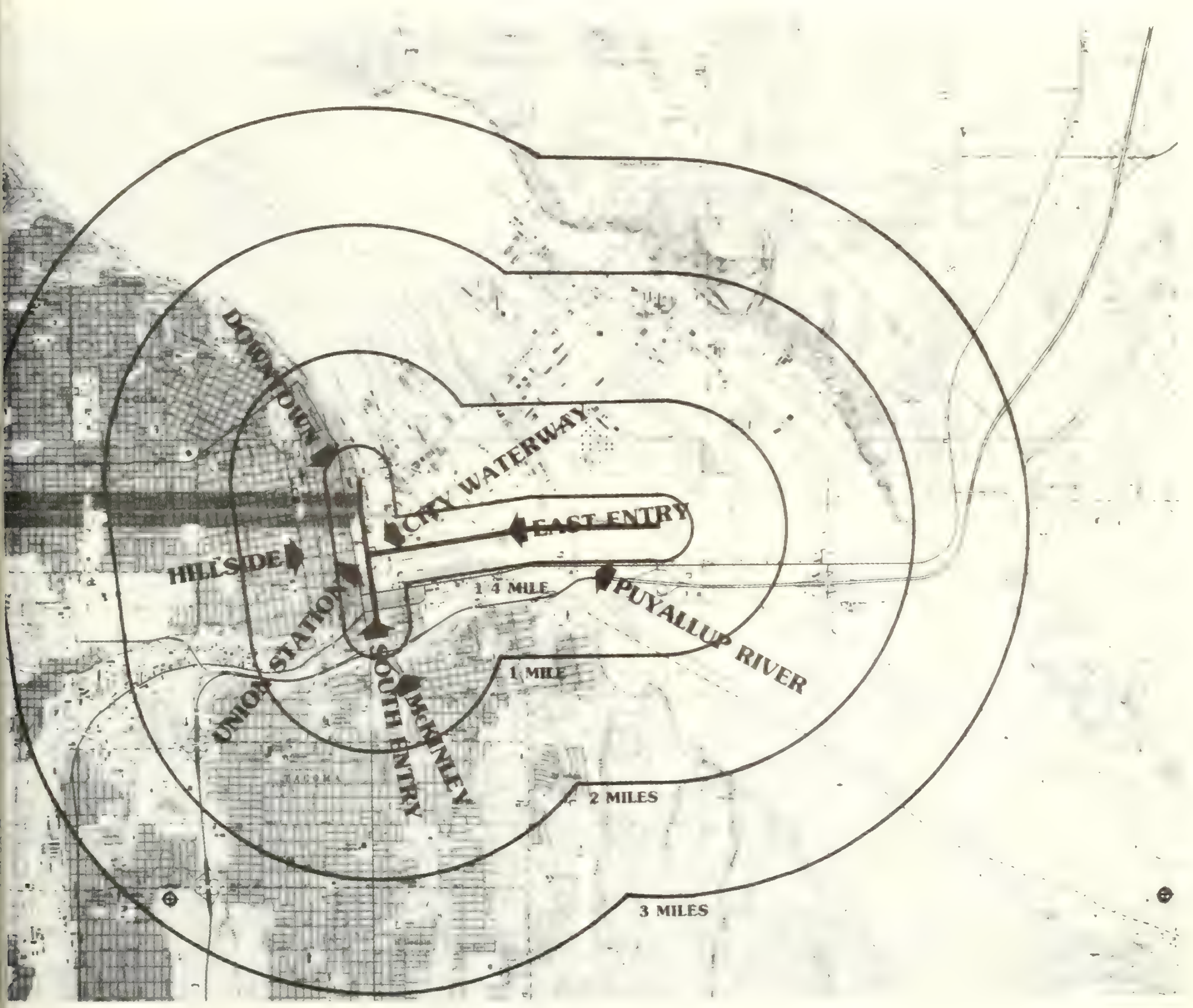
An application of these assessment and management processes, drawn from work in progress, demonstrates the usefulness of the VRM objective in highway decision-making. The example is an urban connector that has recently been added to the Interstate system. At the time of writing, this highway is in the project development stage, following the irculation of the Draft EIS. The corridor as been defined, but (a) final alignment, nd (b) structural concepts are still at issue.

The setting is an urban waterfront. The oad will be an elevated structure over ailroad tracks, between an historic station n a low bank and a redeveloping marina and ixed-use area on the waterfront (fig. 3). ommunity concern over the visual effects of he highway is high because of the cultural ignificance of the station, local plans for he waterfront and local concern over the resent character and quality of northbound ity entry views.

View Selection

There are potential conflicts between the visual needs and desires of two major viewer groups: the highway user and the highway neighbor. The public concern for improving the northbound entry to the downtown implies a high, straight road oriented to views of key buildings, including the station. On the other hand, concern over the road's impact on views of the station from upland areas and from the waterfront implies a low road, close to the bank or terrace, with more limited entry views. The level of community concern suggested the use of simulated views to demonstrate the future appearance of the road.

igure 3--Project corridor (heavy black line), distance zones and location of key views.



The location of these views has been carefully determined because these locations will become "landscape control points" for the conceptual design of the road (Litton 1973). The viewshed of the highway was mapped, using the end and middle points of the corridor and the highest likely roadway elevations (a worst-case assumption). Viewing distance zones were delineated and viewer groups were mapped on the basis of land use and travel routes. Eight key views have been selected as best representing concern. Four of these locations were used to evaluate alignment alternatives because of their importance:

View	Concern
South Entry	Enhance NB entry views
East Entry	Enhance WB entry views
Union Station	Minimize impact on views of station
City Waterway	Minimize impact on views from waterway

These views are located in figure 3 and reproduced in figures 4 through 7. They have been deliberately selected to give the least obstructed and clearest views from actual vie points accessible to the public.

Figure 4--South entry.

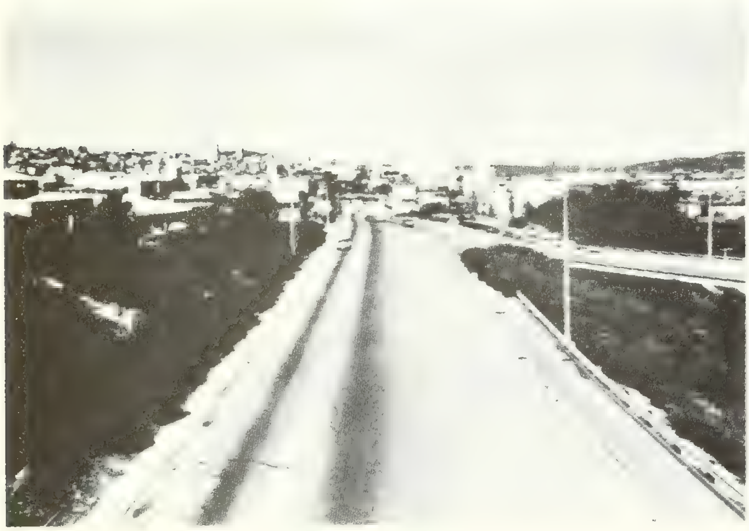


Figure 5--East entry.

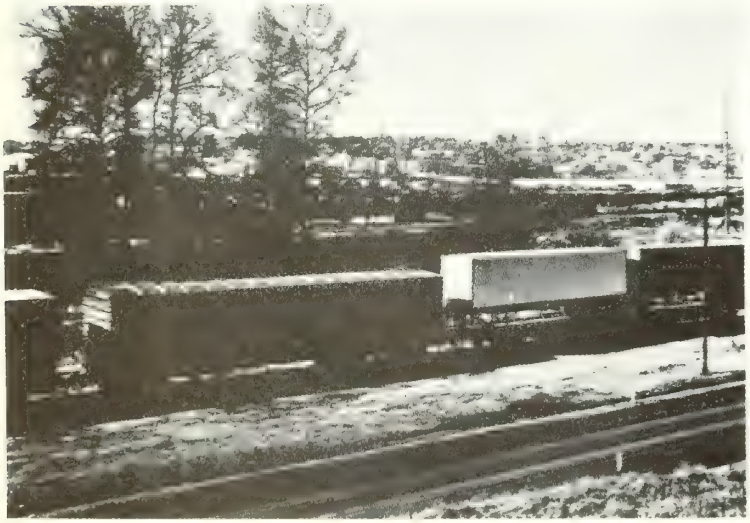


Figure 6--Union station.

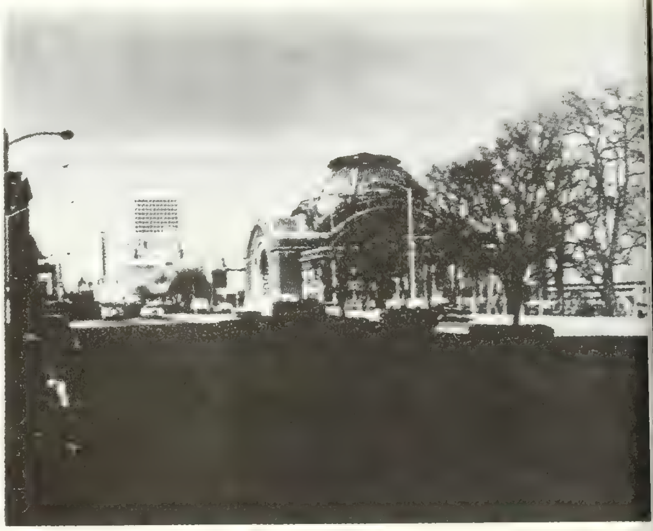
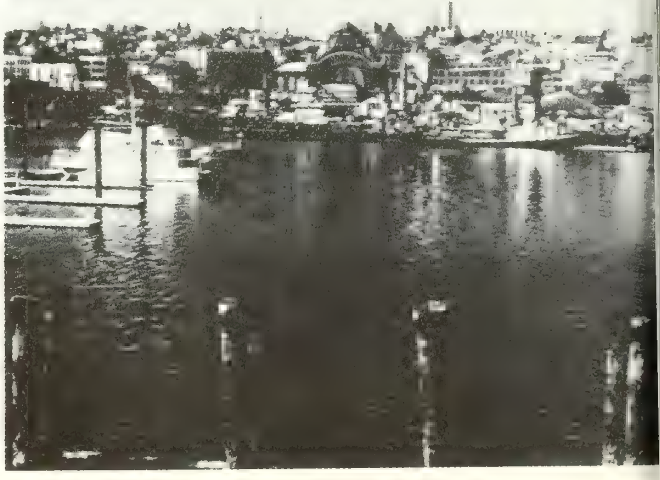


Figure 7--City waterway.



Alignment Selection

For the development and evaluation of alignment alternatives, black-and-white sketches have been produced from each photograph. Generalized sketches of five concepts have been prepared for each of the four key views illustrated here. These sketches, illustrated in figures 8 through 11, are accurate, though simplified, versions of the key views . Accuracy is essential to their public credibility. Specific VRM objectives for each view have been used to help develop and evaluate the alternative alignment concepts displayed in the sketches; at this stage these objectives are related to viewer exposure:

South Entry--Maximize the duration of the northbound driver's view of Union Station and the PNB building (measure = lineal feet).

East Entry--Maximize the duration of the westbound driver's view of Union Station (measure = lineal feet).

Union Station--Minimize the extent of roadway and structure visible behind and adjacent to Union Station (measure = percent of foreground).

City Waterway--Minimize the extent of roadway and structure visible between Union Station and the water (measure = percentage of foreground).

Figure 8--South entry, alignment concept 1.

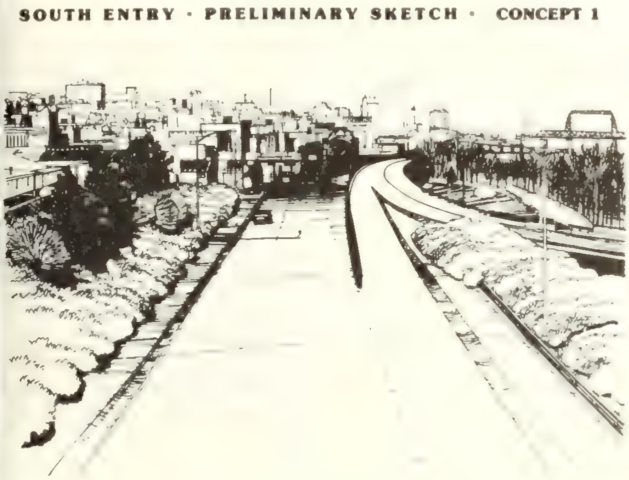

SOUTH ENTRY · PRELIMINARY SKETCH · CONCEPT 1

Figure 9--South entry, alignment concept 2.

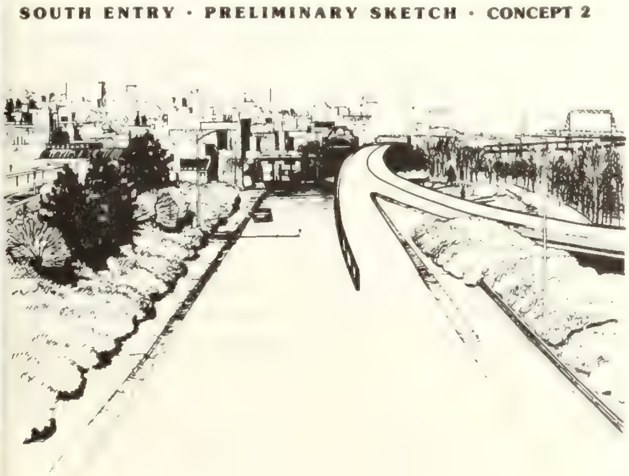

SOUTH ENTRY · PRELIMINARY SKETCH · CONCEPT 2

Figure 10--City waterway, alignment concept 1.

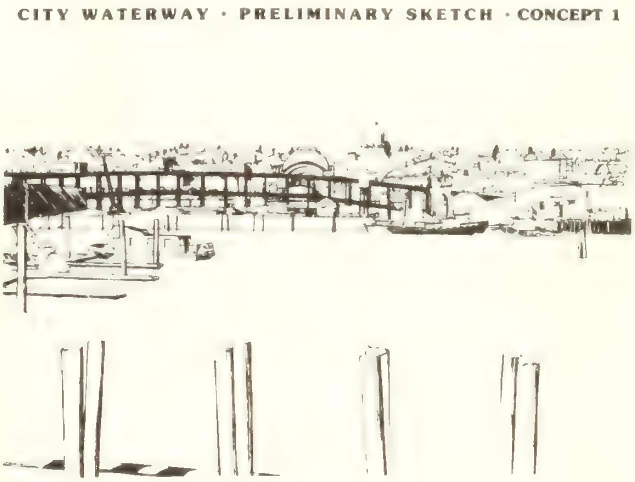
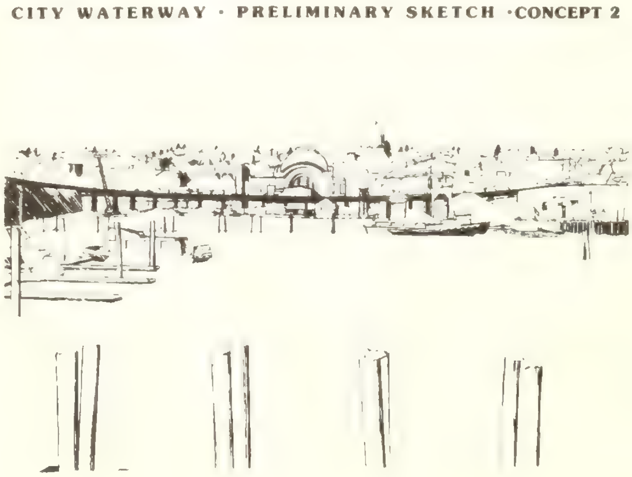

CITY WATERWAY · PRELIMINARY SKETCH · CONCEPT 1

Figure 11--City waterway, alignment concept 2.


CITY WATERWAY · PRELIMINARY SKETCH ·CONCEPT 2

The evaluations of the alignment alternatives in terms of these objectives are summarized in table 1. The rank order of the alignment concepts varies among the objectives. The importance attached to each objective and key view is largely a matter of viewer sensitivity, so members of the community were asked to assign an importance ranking to each of the eight key views. Table 2 presents these rankings, which can be combined with table 1 to identify alignments that best meet the visual criteria. This information is being considered as one input to the alignment selection process, along with engineering, cost and joint-use considerations.

Table 1--Visual effectiveness of alignment concepts (rank order)

Key View	CONCEPT				
	1	2	3	4	5
South Entry	5	2	1	3	4
East Entry	5	1	3	4	2
Union Station	5	1	1	4	3
City Waterway	5	1	2	4	3

Table 2--Perceived importance of key views (number of persons giving each importance rating, where 1 = highest importance, 8 = lowest importance)

Key View	IMPORTANCE							
	1	2	3	4	5	6	7	8
South Entry	5	5	3	2	0	1	0	0
East Entry	0	4	0	0	5	1	3	2
Union Station	4	4	2	5	0	1	0	0
City Waterway	2	4	4	1	1	2	0	0
Downtown	2	1	5	2	3	1	1	0
Hillside	1	1	1	3	3	2	3	1
McKinley	1	0	0	1	3	4	3	4
Puyallup River	0	0	0	1	0	2	4	8

Concept Design

Once an alignment is selected, design effort will be concentrated on development of structural and joint-use alternatives. Additional VRM objectives will be developed to help guide design. These objectives will go beyond viewer response to focus on the visual character of the roadway structures in relation to the urban setting and their effect on the overall visual quality of the project area.

CONCLUSION

This pragmatic and project-oriented VRM approach is very flexible; it directs effort to the specific visual resource or viewer response concerns that are most important at a particular project location. It has strong implications for design, since it stresses the regional context, the importance of assessing projects from key viewpoints used by the public, and directs the designer's attention to a reasoned strategy for visual compatibility and visual quality.

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Highway Attitudes and Levels of Roadside Maintenance[1]

Gary D. Hampe and F. P. Noe[2]

Abstract: Over eight-hundred users of the Natchez Trace Parkway were interviewed concerning their preference of degree of grass maintenance and their attitudes toward highways. Those individuals who had a positive attitude toward highways were more likely to prefer those scenes which portrayed a greater degree of maintenance than those individuals who did not have a positive attitude toward highways. The degree of maintenance along highways can be related more directly to the user's attitude if such attitudes are known.

INTRODUCTION

Sensitivity to the landscape of the environment has recently received increased emphasis among governmental agencies in response to perceived societal needs. A basic theme which pervades much of the newly developing body of research on landscape aesthetics focuses upon the issue of man's modification of nature. The issue arises about the degree of man's development of a natural environment which still remains compatible with the natural scenery. Man-made intrusions in nature may detract from the composition of scenery and the pleasure which individuals can derive from that scenery or add to it. There is nothing intrinsically moral about man aesthetically changing his environment. However, the way these changes are accomplished does at times result in controversy because of the existence of different aesthetic value systems.

This research inquiry focuses upon a dilemma involving degree of maintenance and the kind of fencing found along a parkway and how much distraction occurs from the naturalness of the scenery. The aesthetic quality of roadside maintenance and the intrusion of man-made objects alongside highways in the United States are less sensitive issues because of no long-established tradition about such maintenance as in some European countries which maintain or build distinct parks, gardens and stone or briar hedges.

The problem of evaluating the aesthetic value of a fence or a roadside may not appear as a resounding moral or national issue in relation to energy, work, or crime; but for a land management agency such as the National Park Service which is charged with providing a scenic experience along its parkways, the problem becomes very real. The relevance of this issue is made even more salient since scenic value has become equated with economic value (Iverson 1975:275): "Taking the basic premise that scenic values result from scenic quality and the market for scenery, we need to know what constitutes scenic quality and its marketability." The effectiveness of roadside appearance along a parkway may contribute to the marketability of that roadway as a scenic site.

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[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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PREVIOUS RESEARCH

Previous analysis into the value of nature in outdoor environments was reported by Moeller (1974:6) who indicated that the "natural environment, taken as a wholistic entity, is viewed favorably by all recreationists." Irrespective of how the natural environment is pictured, whether as lake, mountain or forest, the view was appreciated as pleasing to the recreationist despite the wide variety of activities pursued in the outdoors. The propensity among viewers was towards naturalistic scenes where "landscapes were predominantly natural or consisted of natural materials such as in agricultural areas" (Zube et al. 1975:154). Scenes pertaining to nature were also anthropomorphized by describing physical phenomena in which "behavioral terms" or "unexpected sensory attributes" such as "peaceful," "quiet," or "desolate" indicated but a few of the kinds of connotations used to identify sites (Dunn, 1976:23). At best, the pervasiveness of nature or signs of naturalism are apparently highly valued as meaningful perceptual phenomena or strongly identified with man.

Social factors help induce man toward increasing his preferences of concern for outdoor landscapes which very often include fences. The results of a study by Carls (1974:122) strongly indicate that "numbers of people and level of development have a noticeable effect on a preference for outdoor recreation landscapes." The level of preference for a landscape is reduced as the presence of individuals increases and as higher levels of development take place on particular sites. The relationship between a natural environment and preferences is not directly attributable to an immutable value orientation but varies considerably among individuals and site conditions. An obvious area of exploration has centered upon motives for utilization of the environment. "Motivation and purpose in the environment influence perception. This motivation is significant because what an individual attends to in an environment depends on his purpose" (Haskett 1975:6-7).

THE PROBLEM

The evaluation of motivations for traveling along the parkway, recreational involvement, and attitudinal behaviors reflecting roadside attitudes was included in the analysis in order to determine differential preferences for degree of maintenance along the parkway. Since roadside maintenance constitutes a man-made development, we anticipated that there would be preferential differences among choices of selected scenes that were more natural as opposed to those scenes that appeared less natural in relation to the surroundings.

Not only had previous studies indicated that natural scenes were highly desirable but the man-made artifacts appearing in naturalistic scenes were reported as negatively detracting from their value (Hampe 1973:43, Zube 1973). Gross as well as subtle comparisons between natural as opposed to developed lands have been reported that indicate that when man-made objects appear in a natural scene, the result is a downgrading of the scene (Linton 1968). The question remains which type of scene will be preferred when individuals are presented the choice between similar scenes with some that are more natural as opposed to those exhibiting more man-madeness in design.

METHODS

Data for this study were collected in July 1977, October 1977, and April 1978. On each occasion, interviews were conducted on a Friday and the following Saturday. Three interview sites used for all interviews were the Ridgeland Information Center, Mississippi, Jeff Busby State Park, Mississippi, and Colbert State Park, Alabama. These sites represent locations on the Natchez Trace Parkway from the southwest section to the northeast section of the Parkway.

Motor vehicles were stopped at random every twenty minutes until the number stopped equaled the number of interviewers at the site. If by chance a vehicle had been stopped at another site, it was not included in the study a second time. Each interviewer had a list of random numbers for determining which individual over 15 years of age,(the age at which an individual could legally drive) within a vehicle would be interviewed. Because the arrival of vehicles at a particular site is random and because the random numbers were used in selecting the interviewee, it is felt that a simple random sample of the vehicles and passengers traveling the Natchez Trace Parkway on a Friday and Saturday was collected. The refusal rate was approximately 5 to 40 percent depending upon the time of day.

The respondents were shown three sets of scenes which were taken along the Parkway.

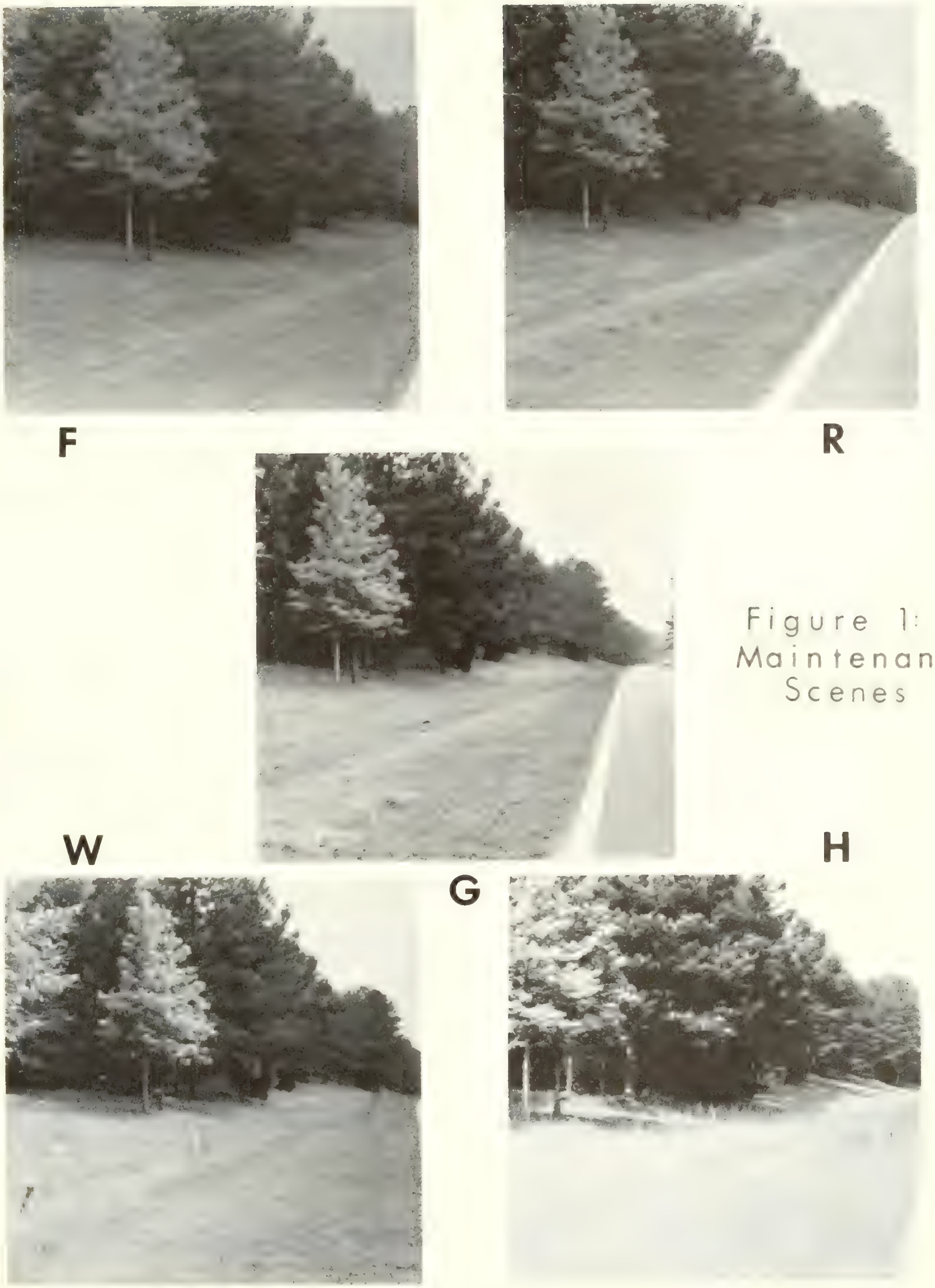

Figure 1: Maintenance Scenes

of variance. The differences within the scenes using both methods were statistically significant at $P < .001$. The focus of this analysis is not upon the overall order of the ranking of the scenes *per se*, but upon the extent of the influence of highway attitudes on the preference for the individual scenes.

Grass Maintenance Scenes and Highway Attitudes

Statistically significant relationships between the ranking of a scene and agreeing that billboards make a trip more interesting ("billboard") were found for three of the grass maintenance scenes (See Table 1). No differences were found for the most highly preferred and maintained scene--F. Individuals who agreed with the "billboard" attitude were more likely to rank scenes R and G first rather than last and were also more significantly likely to rank Scene H last rather than first. The relationships in Table 1 were controlled for the effects of residence within the East South central (Mississippi, Alabama and Tennessee) region of the U.S. as compared to other regions of the U.S. The relationships remained in the same direction for those individuals living in the South but no real relationships were observable for those living outside the region, except for Scene W where those who agree with the "billboard" item were significantly more

Table 1--Attitudes Toward Billboards by Grass Maintenance Scenes Controlled by Region of U. S. Where Respondent Resides (Percent who agree billboards make a trip more interesting)

Rank of Scene	F	R	G	W	H
	Total Sample				
1	35.3 (464)[1]	44.9 (176)	44.4 (54)	26.9 (52)	22.8 (57)
2-4	40.8 (306)	34.9 (599)	37.9 (646)	36.7 (602)	36.1 (277)
5	23.5 (34)	31.0 (29)	26.9 (104)	41.3 (150)	39.2 (470)
X^2	5.140[2]	6.284*	6.055*	3.496	5.956*
τ	-.026	.074*	.066*	-.052	-.064*
	East South Central U.S.				
1	39.0 (395)	48.6 (140)	45.8 (48)	30.9 (42)	21.4 (42)
2-4	43.3 (251)	38.2 (505)	41.0 (541)	40.6 (488)	38.8 (232)
5	25.0 (24)	32.0 (25)	30.9 (81)	41.5 (130)	42.9 (346)
X^2	3.635	5.607	3.728	1.618	7.576*
τ	-.018	.077*	.056*	-.029	-.081*
	All Other Regions of U.S.				
1	10.8 (65)	25.0 (32)	33.3 (6)	0.0 (9)	26.7 (15)
2-4	24.0 (50)	13.5 (89)	17.5 (97)	15.2 (99)	17.1 (41)
5	20.0 (10)	25.0 (4)	9.1 (22)	35.3 (125)	14.5 (69)
X^2	3.618	2.432	2.145	6.170*	1.309
τ	-.120	.073	.078	.135*	.066

[1] The percentage to the left of the number in the parentheses indicates the proportion of individuals who fall into that particular category. In this case 35.3 percent of those individuals who ranked Scene F as first (N = 464) agreed that billboards make a trip more interesting as compared to 23.5 percent of those who ranked Scene F as last (N = 34) who thought billboards make a trip more interesting. This method of presenting the data is followed in this table and throughout any other table unless specified otherwise.

[2] X^2 is the chi square statistic, while τ is Tau C. An '*' following the chi square statistic and/or the Tau is to indicate that the statistic is significant at $P \leq .05$.

The first set consisted of grass maintenance scenes, the second set was fence scenes and the third set was of general scenes of the Parkway. Each set consisted of five scenes which were 5" x 7" color photographs of consistent quality. Each of the three sets of scenes was mounted on a large white art board so that the respondent could compare within each set and rank the 5 scenes from first to fifth. This analysis is concerned only with the maintenance scenes. Over 800 respondents were able to do this for all three types of scenes except for a few who had difficulty with the grass maintenance scenes.

Measures of the Independent Variable

Two questions were used in the interview schedule to determine the attitudes the respondents felt toward a highway or roadway. The respondents were classified as having a high road orientation if they agreed with the statement:

> Most billboards help to make a trip more interesting,

or if they disagreed with the following statement:

> Most of the man-made objects found along roadsides are eyesores.

The analysis is concerned with the relationship of these two attitudes and choice of maintenance scenes.

The Dependent Variable

The dependent variable was each grass maintenance scene of which there were five, representing varying degree of maintenance (See Figure 1).The most maintained scene was F having the grass cut up and around the trees; next most maintained was R,with the grass cut up to the tree line; then came G, with the grass cut to the swale of the ditch; then fourth in terms of maintenance was H,with one mower swath done alongside the highway; and last in maintenance was W, where no grass had been cut at all.

Hypothesis

We hypothesized that individuals who possessed a high road orientation would prefer roadside scenes which indicated a higher degree of maintenance as measured by grass levels.

This belief that if one possessed a high-road orientation, this would affect the choice of scenes along a parkway was based on the premise that "landscape elements are physical features of the environment that are either naturalistic, man-made, or exhibiting both natural and man-made characteristics." (Haskett 1975:2). The range of landscape elements can be expressed as a continuum between the extremes of purely natural and entirely man-made features. The distinction is rather simplistic but useful in that it does identify the limits of norms within which a more meaningful context for evaluating such items as grass maintenance.

Type of Analysis

The relationships between the ranking of each scene and the two highway attitudes were analyzed by using the chi square statistic for the test of significance and Tau_c for a measure of association. Each relationship was controlled for background factors such as age, education, sex, socioeconomic status, etc. No real difference was found on the zero-order relationship by these variables. Control variables dealt with reasons for using the Parkway and other related background factors. The results are presented for the zero-order relationship between highway attitudes and the rank of scenes controlled by region of the U.S. where the respondent resides. This variable was highly associated with factors such as region of U.S. where raised, reason for using the Parkway, frequency of use and distance driven on the Parkway. Region of U.S. was the most important control variable in that it included the effects of those other variables.

RESULTS

Rank of Scenes

The order of preference from first to last of the grass maintenance scenes was F, R, G, W and H, respectively.[3] The ranking of the scenes was examined using one-way analysis of variance and also Kruskal-Wallis analysis likely to rank this scene last of all.

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[3] The means are F (1.782), R (2.238), G (3.128), W (3.647) and H (4.144), where a mean of 1 would indicate the scene was chosen first and a mean of 5 would indicate that the scene was chosen last.

The relationship between the choice of maintenance scenes and disagreeing with the item that stated most man-made objects along a roadside are eyesores ("eyesore") was statistically significant for Scenes G and H, the third and fifth ranked scenes overall for the total sample (See Table 2). The relationship within Scene G and H showed the same relationship as discussed concerning the "billboard" item. Those with a positive highway attitude ranked Scene G first more than last and ranked Scene H last more than first. When controlled for region of the country, the relationship was significant for those who lived within the South, but not for those outside the region, although the direction of the relationship was the same as found at the zero-order level.

some which are quite similar to one another, on a continuum from most preferred to least preferred. All these scenes showed the effect of maintenance or lack of it in some way. Secondly, individuals with different attitudes will rank these scenes somewhat differently--in this case the attitudes examined were attitudes toward highways and their roadsides. Third, and perhaps most important for planners concerned with highways, the degree of maintenance preferred along a highway can vary considerably given the attitudes of those who use them. This means if one knows the attitudes of the average user, adjustments can be made accordingly in the degree of maintenance or in the changing of the attitudes themselves. Last, the results presented here are only a partial analysis of the kind of reasons why individuals rank scenes along a highway the way they do.

Table 2--Attitudes Toward Roadside Objects by Preferred Grass Maintenance Scenes Controlled by Region of U.S. Where Respondent Resides (Percent who disagreed that most man-made objects along a roadside are eyesores)

Rank of Scenes	F	R	G	W	H
	Total Sample				
1	50.1 (464)	54.0 (176)	51.8 (54)	39.2 (51)	31.0 (58)
2-4	49.4 (306)	46.9 (599)	50.8 (646)	48.5 (602)	48.4 (277)
5	32.4 (34)	55.2 (24)	34.6 (104)	53.0 (151)	51.2 (469)
X^2	3.826	3.213	9.583*	2.951	8.402*
τ	.030	.037	.075*	-.049	-.073*
	East South Central U.S.				
1	50.8 (388)	55.0 (140)	52.1 (48)	37.5 (40)	30.2 (43)
2-4	48.8 (250)	47.8 (498)	51.7 (534)	49.3 (493)	50.0 (228)
5	37.5 (24)	54.2 (24)	33.8 (80)	54.3 (129)	51.4 (391)
X^2	1.682	2.484	9.086*	3.483	6.976*
τ	.035	.039	.077*	-.058*	-.062*
	All Other Regions of U.S.				
1	30.0 (60)	46.9 (32)	50.0 (6)	25.0 (8)	33.3 (15)
2-4	46.9 (49)	31.3 (83)	37.6 (93)	37.2 (94)	28.2 (39)
5	20.0 (10)	50.0 (4)	25.0 (20)	35.3 (17)	41.5 (65)
X^2	4.585	2.764	1.665	0.484	1.936
τ	-.086	.094	-.021	-.109	-.109

SUMMARY AND SUGGESTIONS

The main research finding was that having a positive attitude toward billboards and believing that not all objects along the roadside are eyesores did have an influence upon the aesthetic interpretation of a scene. Such individuals were more likely to rank first those scenes which were neater in appearance and showed the efforts of maintenance.

Several implications can be drawn from this research. First, individuals can quite easily rank highway or roadside scenes,

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A Method for Improved Visual Landscape Compatibility of Mobile Home Parks[1]

Daniel R. Jones[2]

Abstract: This paper is a description of a research effort directed to improving the visual image of mobile home parks in the landscape. The study is an application of existing methodologies for measuring scenic quality and visual landscape compatibility to an unsolved problem. The paper summarizes two major areas of investigation: regional location factors based on visual values, and site design techniques for visual improvements. The findings are most applicable to non-arid regions with forests and land use patterns similar to Pennsylvania.

INTRODUCTION

Mobile home parks are increasingly the focus of several issues of concern for the urbanizing landscape. Rising costs for conventional housing have intensified the market interest in manufactured homes, to the extent that mobile homes now represent the majority of new housing units in many rural areas. Nationally, 5.3 million people live in 3.4 million mobile homes, according to the 1975 Annual Housing Survey. During the 1970's, one third of all new single family housing have been mobile homes.

Although the image of the mobile home park has improved in the last 15 years, mobile homes continue to suffer from poor public acceptance. While specific attitude studies have never been conducted, conjectural evidence would suggest that appearance, cost, perceived transient nature of residents, tax laws, and other factors all contribute to the public's concerns. This paper describes a study that was addressed to the issue of improving the appearance of mobile home parks in the landscape as viewed by the public.

Many communities are ill prepared to deal with mobile home parks, in part due to a lack of guidelines concerning their proper development. While planning for conventional housing can be quite sophisticated, mobile homes are misunderstood and regulated in inappropriate and ineffective ways. Towns with well organized planning and zoning apparatus often attempt (with some success) to use regulatory means of severely restricting the development of mobile home parks, or make eventual approval subject to such comprehensive review that most developers are effectively discouraged. Most zoning plans consider mobile homes as "special exceptions," despite their significance in the current housing market.

As a result of this situation, many developers are attracted to outlying areas where planning is not as well organized, where zoning may not exist, and where a mobile home park of mediocre design can be quickly built. In Pennsylvania, these outlying townships are being saddled with far more than their fair share of the mobile home park "burden." Because of the nearly universal discrimination by well organized towns, good developers have ifficulty demonstrating potentially improved echniques. Good mobile home parks need good ocations, and most communities allow mobile omes only in locations that are undersirable or conventional housing. Typical development ites known to the author are associated with andfills, industry, powerlines, airport flight aths, or interstate highways. Good developers ave problems overcoming their poor image, but outinely find themselves in expensive litigaion proceedings to build even in poor ocations.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23 - 25, 1979.

[2] Daniel R. Jones, Assistant Professor of Landscape Architecture, The Pennsylvania State University, University Park, Pennsylvania. This study was supported by the National Endowment for the Arts: Principal Investigators, Daniel R. Jones and A. Mark Battaglia.

A clear need exists for improvement by oth towns and developers. Because costs have orced such a significant segment of the popuation to consider manufactured housing as the nly practical alternative to home ownership, unicipalities have the responsibility to rovide for orderly and fair integration of his housing type into the fabric of the ommunity. In 1976 the state of Vermont delared in Act 236: "In writing of the omprehensive Plan, a municipality should onsider population, income, employment characertistics and the housing needs, present and rojected, for all economic groups within the unicipality and region. Specifically, no oning regulation shall exclude mobile homes, odular homes, or prefabricated homes from the unicipality, except on the same terms and onditions as conventional housing is excluded. obile home parks may not be prevented either."

At the same time, developers of mobile ome parks must upgrade the image and livebility of these developments so that increased cceptance is deserved. Better techniques for ocation selection, master planning, and park esign are needed. More involvement by land lanners and landscape architects is needed to dentify and implement such improvements. This roject represents research into one factor f increased acceptance: improving the visual mage of mobile home parks as viewed in the andscape by the public.

PROJECT DEFINITION

Goals

The major goal of the study was to identify ractical means of improving the visual compatibility of mobile home parks with their suroundings and to reduce thereby their negative isual impacts on neighborhoods and regions. ub goals formed the basis for the direction nd scope of the project, and included the ollowing:

1. Economic: to identify means of mprovement that are compatible with the conomic limitations posed by typical rural obile home development costs. There are any examples of luxurious mobile home parks which solve many of the associated visual problems, but most of these resort type developments are unrealistic in economic terms for the average mobile home developer.

2. Social: to identify means of improvement that will benefit the general public which sees mobile home parks in the landscape. A secondary goal was to improve the residential characteristics of the parks for the users.

3. Political: to develop alternatives which have a reasonable expectation of transferability of the results to practical use in ordinance and regulations.

4. Functional Adequacy: to develop improvements that recognize typical layout standards for mobile home parks with respect to circulation, density, open space, utilities, etc.

5. Adaptability: to develop a range of improvements that is adaptable to many types of landscape settings, and to illustrate a range of improvement techniques which may be applied in as limited or comprehensive a way as may be required in an individual situation.

Assumptions

1. The unpopular image of mobile homes and mobile homes parks is at least partly a result of their appearance in the landscape. While many factors may influence public opinion, and while no specific opinions, survey, or perceptual study of this issue exist, considerable conjectural evidence suggests that appearance is a critical issue.

2. The visual perception of mobile home parks by the public is similar to that of experienced designers, and that visual improvements developed by designers will be recognized as improvements by the public. Several well organized research efforts have identified strong correlations between professional and public standards of scenic beauty (Shomaker, Worden 1977).

3. The attitudes of people toward mobile homes are affected by their visual settings in groups, and not only by the appearance of the unit itself.

4. The mobile home as a unit will not change in material, color, or form. Complex marketing factors suggest that significant changes in these areas are unlikely in the near future.

Limitations

1. Only mobile home parks in rural or suburban settings in the Northeast or Midwest of the U.S. were considered because of similar landscape characteristics.

2. Consideration was given to mobile home parks only, and not to the individual mobile home which represents a different set of factors.

3. Research was limited to the visual characteristics of mobile home park siting, although many other environmental factors affect their placement such as slopes, drainage and soils.

Method

1. Literature Survey: a review of existing literature pertaining to mobile homes and visual management techniques was conducted. It was concluded that while a considerable amount of attention has been focused on the mobile home industry, very little effort has been directed to their impact as a land use or as objects of design.

2. Travel: mobile home parks in many landscape settings were observed and analyzed with the intention of clarifying the nature of the visual problem.

3. Interviews: several prominent developers and designers of mobile home parks were consulted concerning economic, social, and political implications and current design standards.

4. Problem Definition: a theoretical model of the visual problem posed by mobile home parks was developed. Two prevailing concepts of scenic quality were utilized. One, identified by many researchers, contends that landscape complexity is a primary component of scenic preference. Second, the visual relationship between adjacent land uses, a principle called "visual landscape compatibility" by W. G. Hendrix and J. Gy. Fabos (1974) was utilized.

5. Design Response: in this phase, several prototypical solutions for different landscape settings were developed.

6. Technical Response: implementation techniques specific to the design solutions were identified.

RESULTS

Regional Scale

The location of mobile home parks in a community or region is very influential to t establishment of image quality. The landscape offers wide variation in its abilities to accommodate visually new land uses. In order to identify a means of locating mobile home parks in ways that result in the least visual impact to a region, a visual sensitiv model was developed and mapped for a central Pennsylvania township for which existing information was extensive. The most sensitive areas will be those with high scenic ratings low visual absorption capacity, and within a viewshed of a major highway. Mobile home parks located in areas with low scenic ratin high visual absorption capacity, and not see from a major road will result in minor visua change to the region. The model was an application of two existing methodologies for visual assessment.

This model allowed:

1. that other major mobile home park location factors are satisfied (access, economics, zoning, proximity to utilities, et

2. that other major environmental factors are satisfied (proper soils, drainage slopes)

The model included the following components:

1. Visual Absorption: (a composite of landscape complexity, vegetation, and topography); a measure of the ability of a landscape to visually absorb mobile home parks. (Jacobs, Way 1968)

2. Visual Landscape Character: a measu of the scenic qualities of a particular landscape, with a ranking of the most attractive landscape units to the least. (Litton, USFS)

3. View from Major Highways: since the image of a region or landscape is primarily gained by the view from major roads, it was concluded that areas outside this "viewshed" are less sensitive to mobile home park development.

4. A final mapped composite of the thre factors results in a measure of sensitivity of the landscape to change by mobile home parks. This method will be useful in selecting locations for mobile home parks in zoning plans, and will be useful in evaluatin the potential level of visual impact of any specific development proposal.

Site Scale

Although selection of zones or districts for mobile home parts may result in better

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[4] W. G. Hendrix and J. Gy. Fabos "Visual Land Use Compatibility as a Significant Contributor to Visual Resource Quality" International Journal of Environmental Studies, 1974 Vol. 1 pages 1 - 8.

sual relationships, there will be many in-
ances when sites with unfavorable visual
aracteristics will be utilized because of
her factors such as location or land cost.
erefore, techniques for the modification of
e visual impact of the mobile home park it-
lf were developed at this scale.

An analogy may be drawn between mobile
me development and an earlier residential
rm that was also subject to criticism and
ncern by designers and the sophisticated
blic. Shortly after the Second World War,
vittown and many other subdivisions spread
er the outskirts of American cities. Photo-
aphed from airplanes, these developments
esented an alarming image of monotony and
mogeneity that posed serious questions as to
e future of the American landscape. However,
ere have been amazing and revealing changes
the Levittowns. At least in visual terms,
range of changes has transformed the former
erile landscape into neighborhoods of
stinctly mellow character. As vegetation has
own, roofs have changed color, additions have
en made, and other typical owner improvements
ve occurred. The traditional means by which
w developments have been absorbed by their
rroundings, not only in Levittown but for
nturies before, are not present in the
pical mobile home park. The units them-
lves do not change except for minimal ad-
tions of porches and side extensions. Be-
use one owner/manager typically controls the
tire site, the landscape will change only to
e rare extent that street trees are planted.
is conceivable that a mobile home park may
ok substantially the same after twenty-five
ars as when it was built. However, deliber-
e attempts to modify the landscape to accomo-
te visually a mobile home park should be
asible.

te Scale Method

1. Lacking specific perceptual research
ncerning the perceived visual "problem" of
bile home parks by the public, the researchers
cided to accept that the great contrast be-
een object and landscape was the primary
use of visual incongruity. From this assumption,
odel for the contrast between an object and
e landscape was developed (Strumillo 1974).
nsidering various combinations of color,
terial, scale, form, complexity, pattern and
e activity, and several landscape types, it
was concluded that a mobile home park achieves a maximum score in most categories. More importantly, limitations concerning changes to the units themselves led to an assumption that more potential for reducing contrast exists in alteration of the landscape. Specifically, two techniques were considered promising enough for further testing:

a. Vegetation can be planted to reduce the scale, increase visual complexity, and connect to existing landscape patterns.

b. The pattern of mobile home layout can be varied to increase visual complexity, reduce scale and improve edge character.

2. In order to portray the potential range of improvements that might be made three large models (200' = 1") were prepared which represented three prototypical landscape settings:

a. A flat, open site.
b. A rolling, open site.
c. A hillside, partially wooded site.

For each model, large mobile home parks (300-400 units) were designed and situated, with both standard layouts and with improved techniques applied. By photographing the models in the various stages of improvement (simulating typical road based views) the effect of singular or multiple applications of the techniques was tested. The major conclusion of this investigation is that the most promising technique for visual improvement of mobile home parks in typical open agricultural sites is to integrate the development with the existing landscape pattern by connecting a series of new hedgerows with existing hedegrows. Alteration of conventional layout patterns with improved layouts resulted in nearly insignificant improvements in visual landscape compatibility.

Figure 1 illustrates the cumulative effect of adding hedgerows to an open hillside site. The ground view is a simulated position of a driver on an adjacent highway. Similar results were achieved from other highway vantage points. As the slope becomes steeper, hedgerows are placed closer together. The integration of hedgerows does not decrease development densities (5 - 6 units/acre). For economical application, it is anticipated that hedgerows may be established through use of small, self-propagating trees, protected for one or two years by snow fence or similar device.

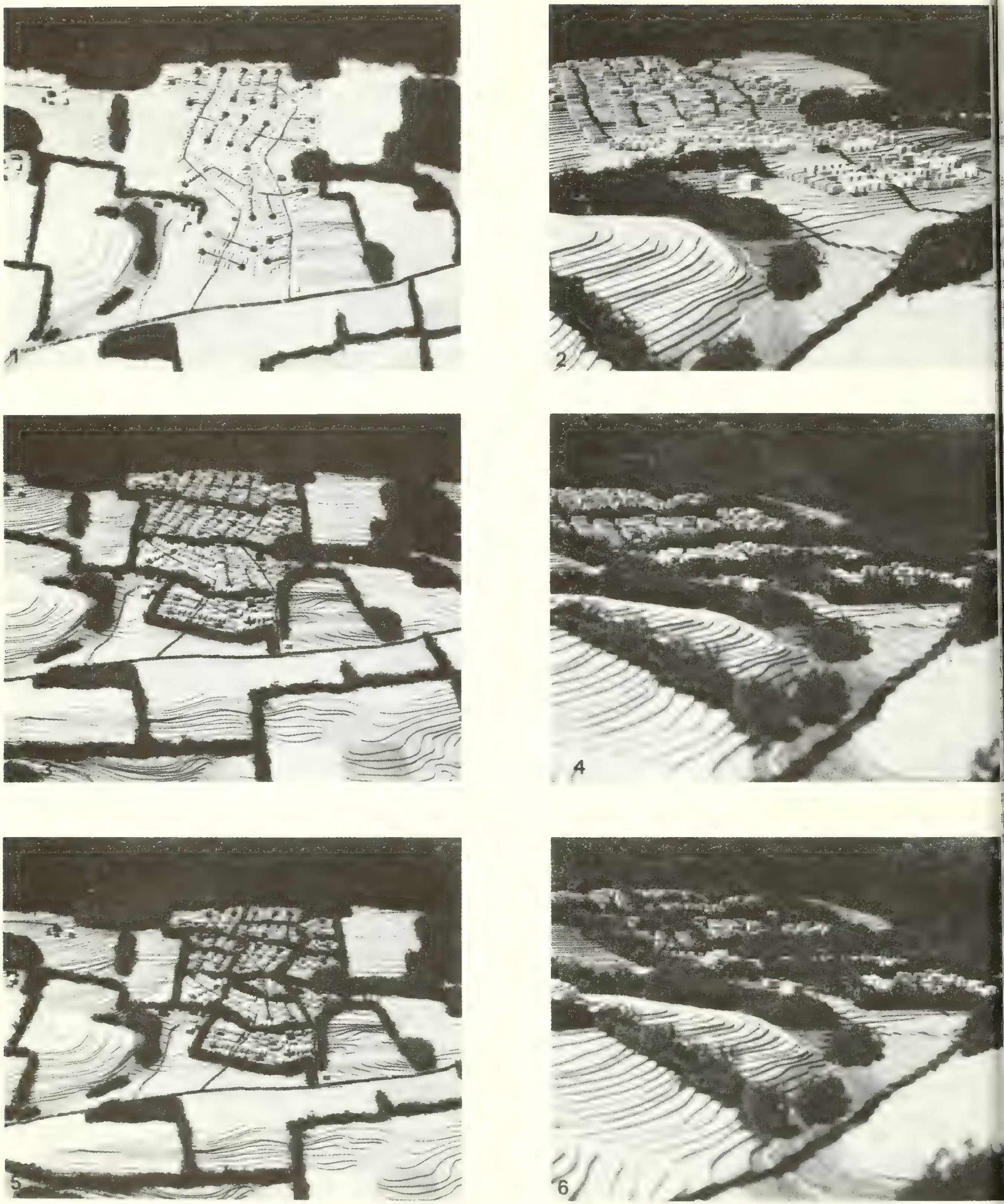

Figure 1

Detail Design

At this scale, certain details were develop-d upon which the site improvement techniques epend.

1. An investigation of hedgerow plantings ed to proposed designs and cost estimates for he establishment of vegetation at these obile home parks. Hedgerow type plantings ere considered the most appropriate because hey take up minimal space, provide maximum isual change, offer windbreak and shade ad-antages, and are inexpensive to establish. The cost of establishing the complete hedge-ow system shown in the example site was stimated at $20,000.00 or 1% of the total ite development costs.)

2. Details for mobile home siting on lopes, for cluster arrangements, and for ntegration of planting were also developed.

APPLICATION

The results of the project should have pplication in the following areas:

1. As a result of the previously cited ourt decision in Vermont, municipalities are equired to accept mobile home parks and to pecify their development requirements. Other tates are likely to implement similar regula-ions. The results of this project can pro-ide guidance for ordinance development, and or eventual increased public acceptance.

2. Developers of mobile home parks could se the techniques for developing improved rototypes. The actual costs of proposed im-rovements are well within the cost framework f typical site development.

3. The residents of such mobile home arks should find their homes to be more leasant and the image of their neighborhood o be more accepted.

4. The same techniques may be applicable o other land uses which pose similar visual roblems such as automobile junkyards.

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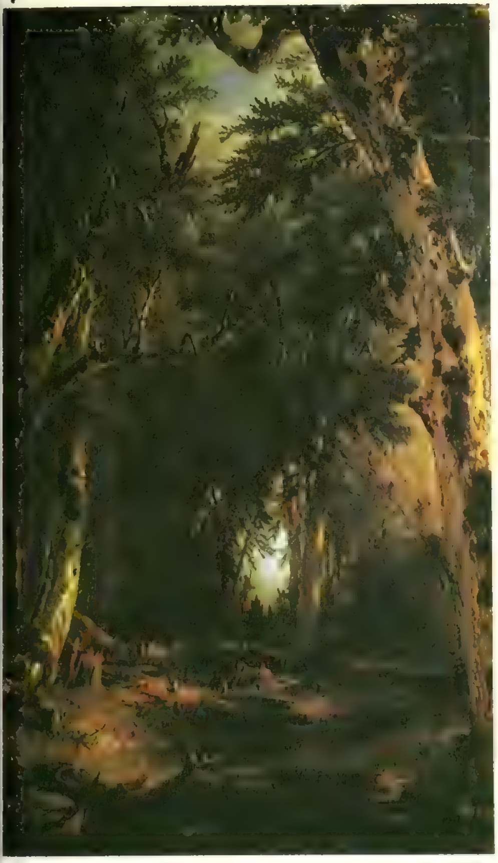
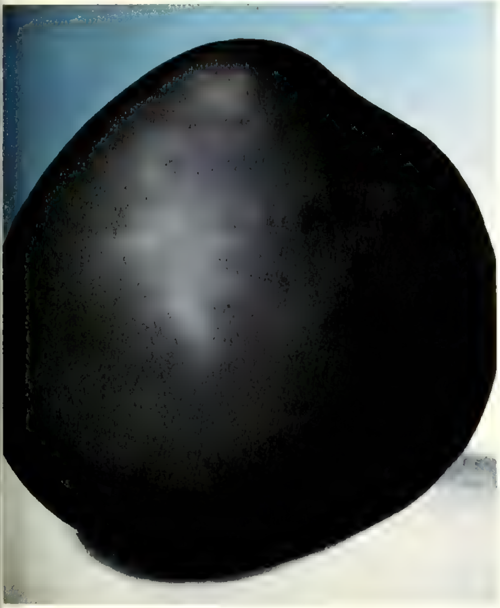
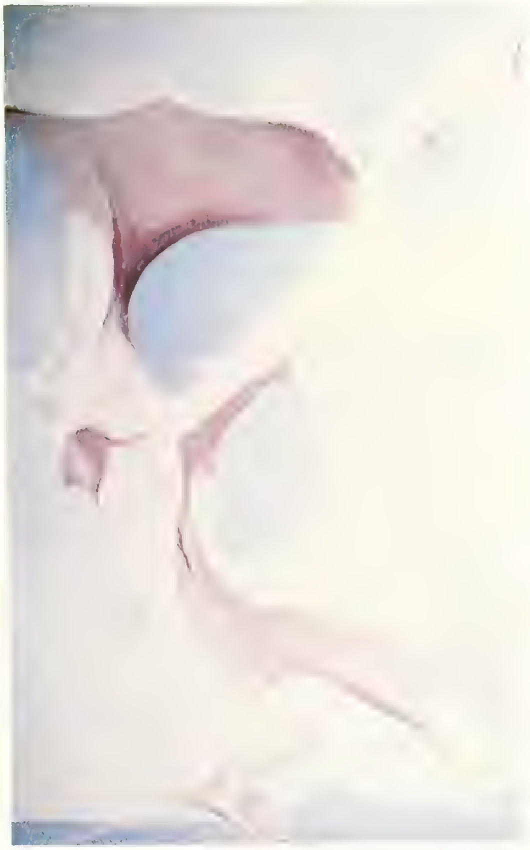
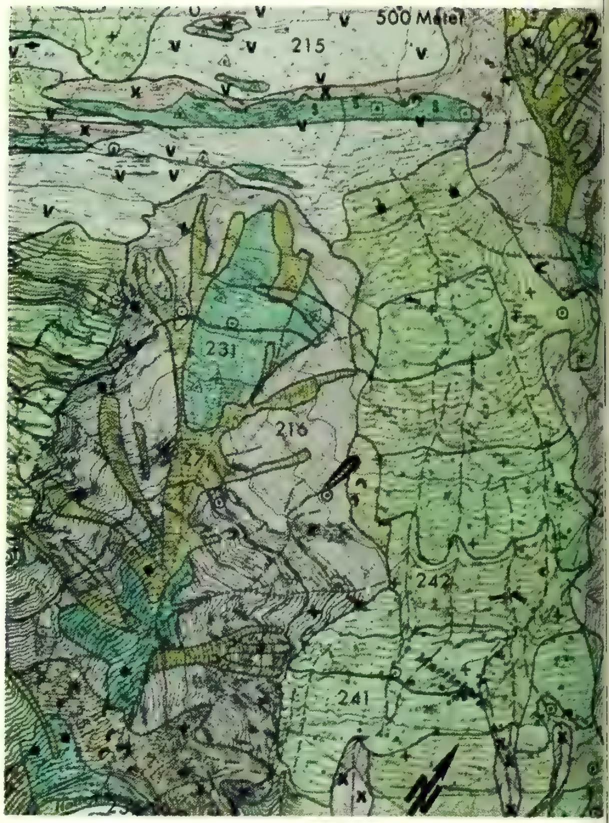
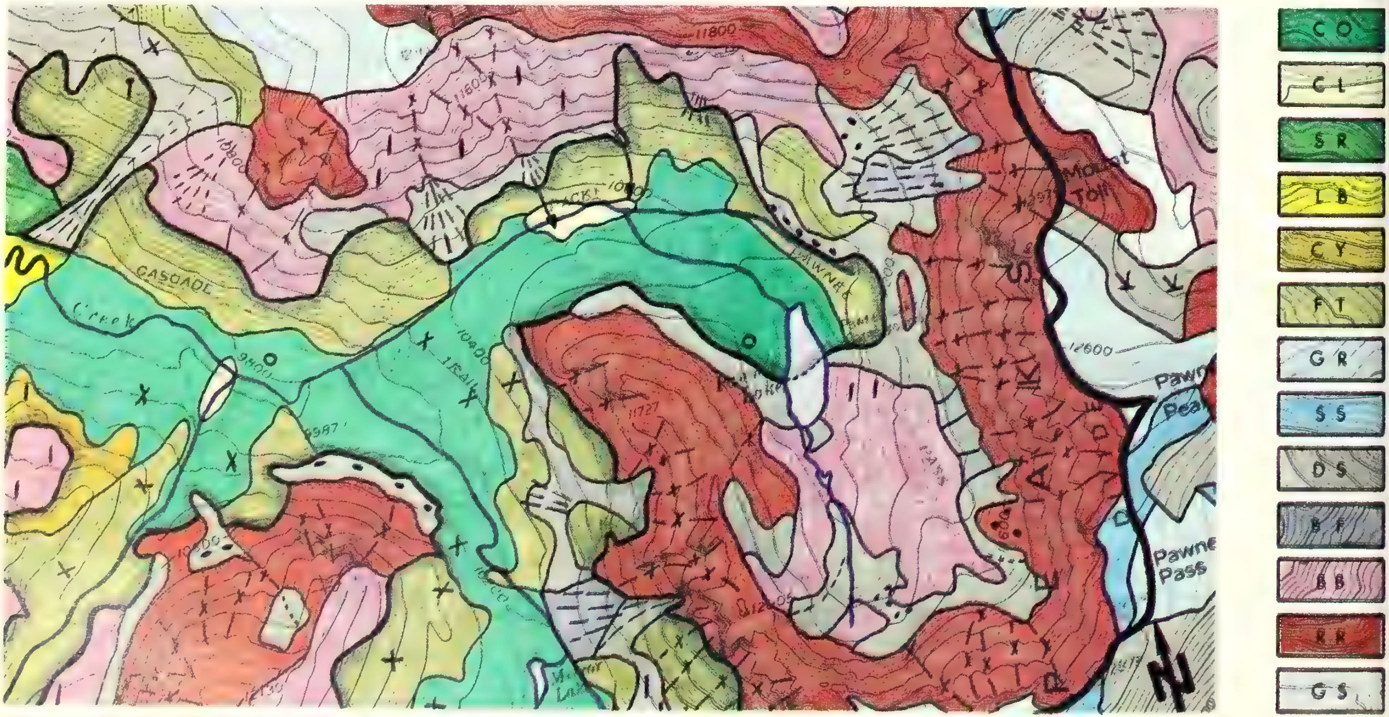






pie: **Figure 1**—Typical painting from the American nature-romantic era.
Figure 3—Thomas Moran, *The Chasm of the Colorado*, 1873-1874.
Figure 4—Georgia O'Keefe, *Black Rock with Blue*, 1970.
Figure 5—Georgia O'Keefe, *Pelvis with Moon*, 1943.

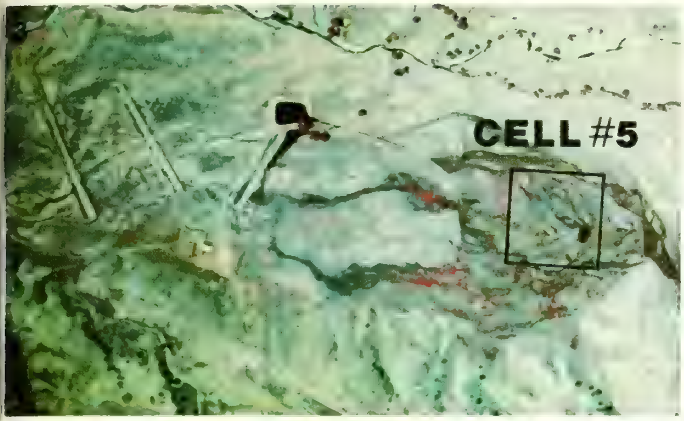


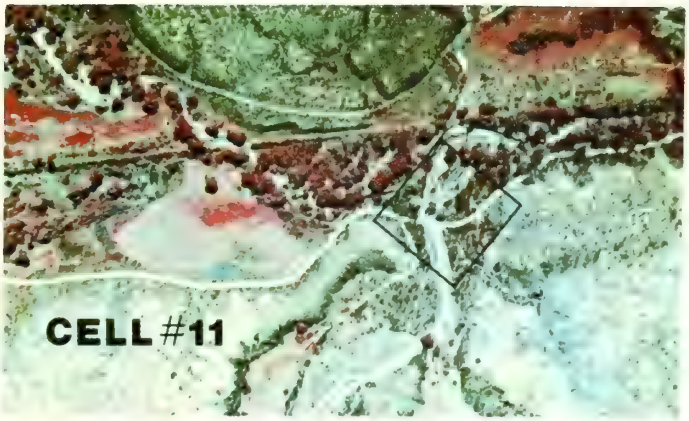


Baumgartner: **Figures 1 and 2**—The landscape of the Aletsch Region (same area on photograph and "Geomorphological Map").

Figure 3—The "Combined Dominant Visual Landscape Type Map" in the Indian Peaks (Colorado).

McCarthy





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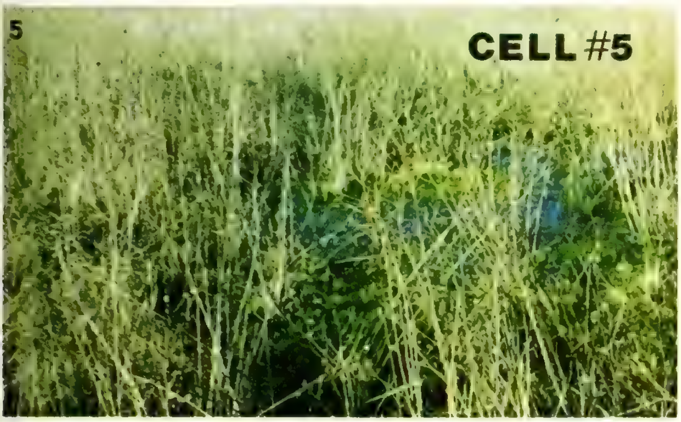

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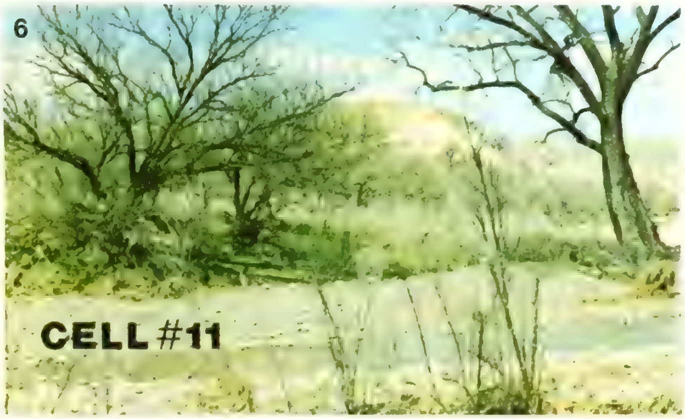

McCarthy:

Figure 3—Color-infrared aerial photo showing location of cell number 5 in the grassland area.

Figure 4—Color-infrared aerial photo showing location of cell number 11 in the riparian woodland area.

Figure 5—Ground level photo of grassland within cell number 5.

Figure 6—Ground level photo of riparian woodland within cell number 11.

Yeomans

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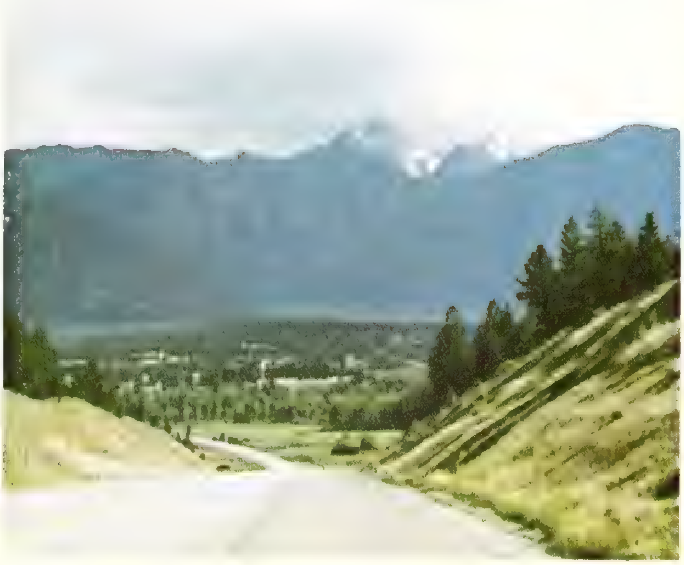
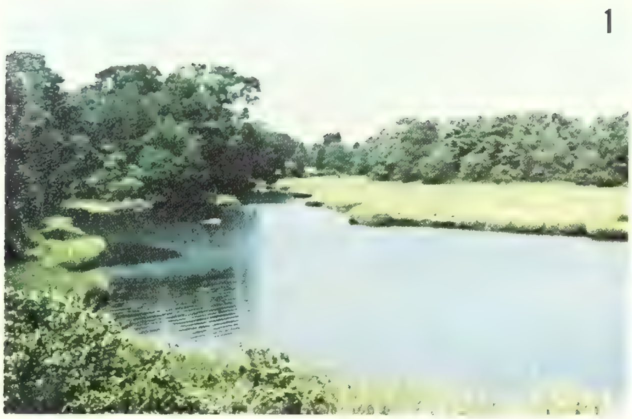
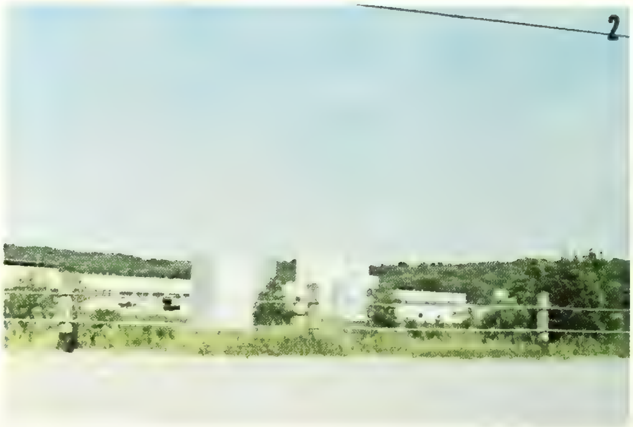
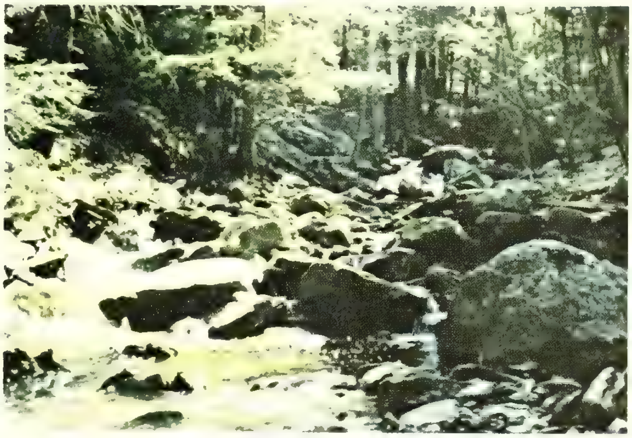


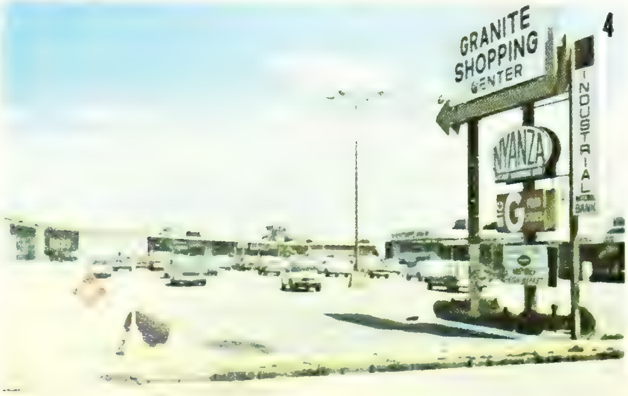
Yeomans:

Figure 3—Much of British Columbia has low VAC because of steep slopes, highly visible from valley floors.









Civco: **Figure 1**—Experimental photograph number 3: Observed Rank Order = 2; Predicted Rank Order = 2; Scenic Quality Adjecti = Scenic.

Figure 2—Experimental photograph number 19: Observed Rank Order = 20; Predicted Rank Order = 20; Scenic Quality Adje tive = Nonscenic.

Figure 3—Test photograph number 2: Observed Rank Order = 1; Predicted Rank Order = 1; Scenic Quality Adjective = Scen Extremely Scenic.

Figure 4—Test photograph number 6: Observed Rank Order = 10; Predicted Rank Order = 10; Scenic Quality Adjective Nonscenic.

Pre-Impact

Post-Impact

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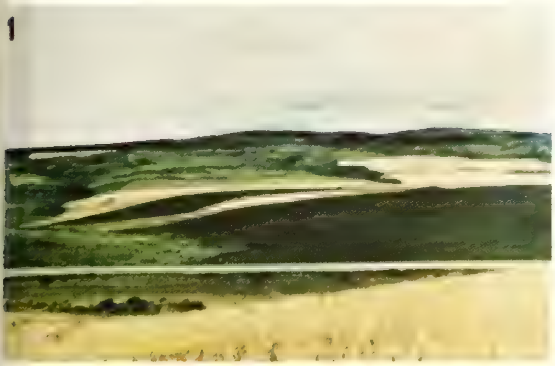

Scene 1

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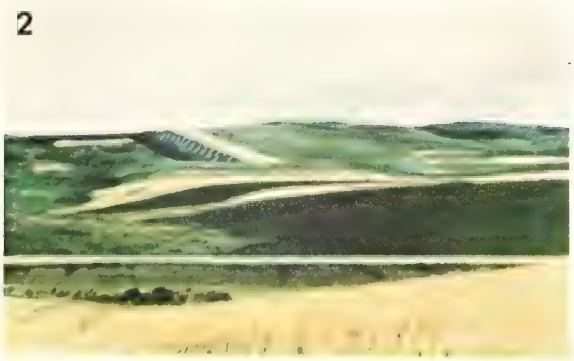

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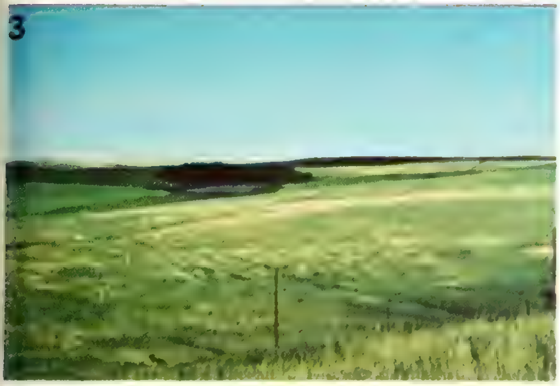

Scene 2

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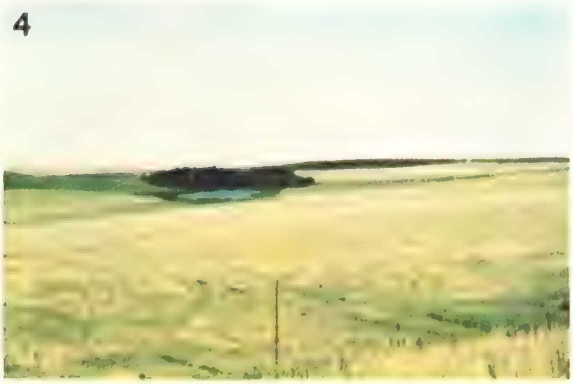

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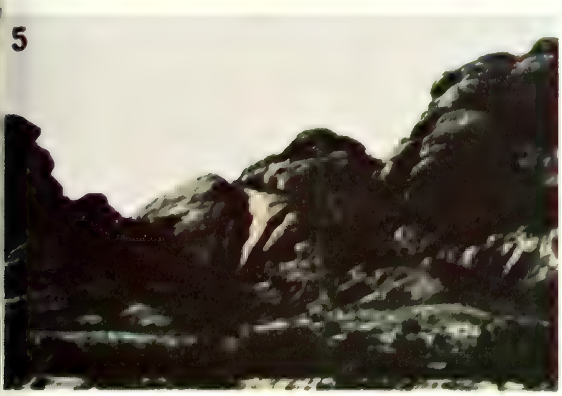

Scene 3

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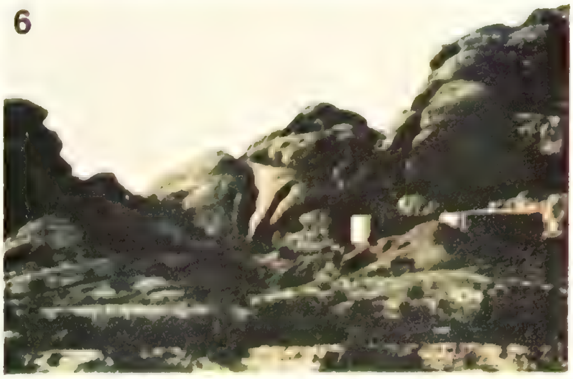

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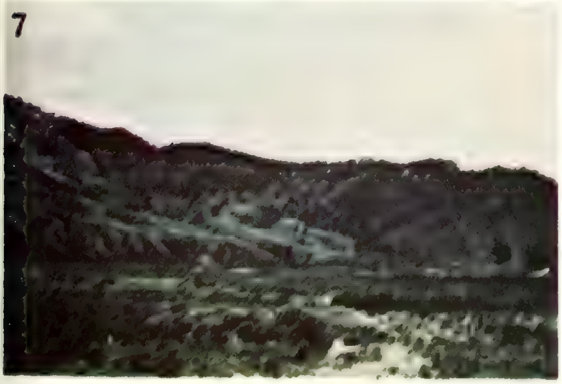

Scene 4

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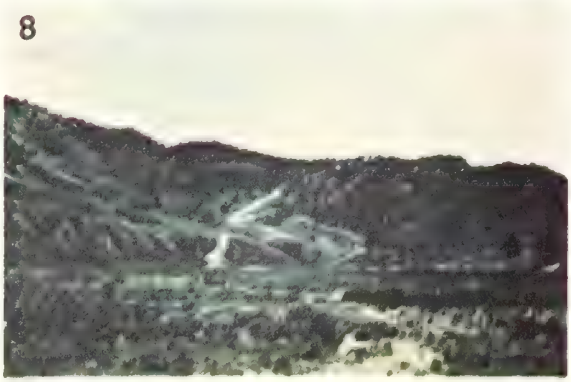

Feimer: **Figure 1**—Pre-impact and post-impact scenes.

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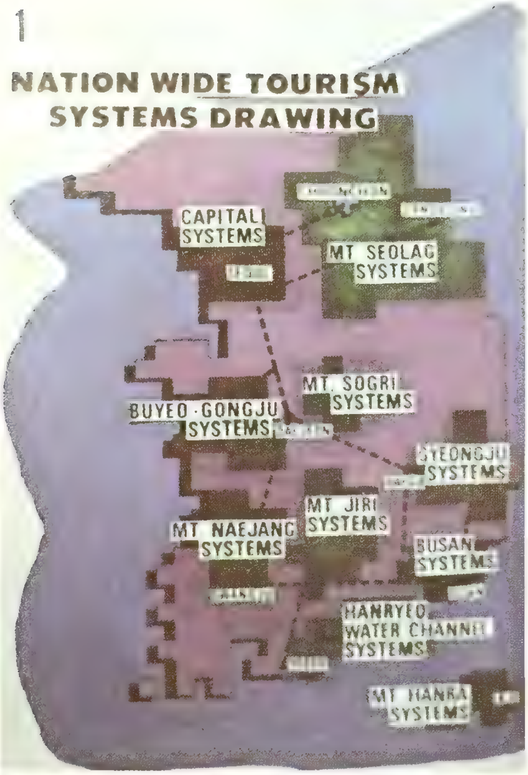

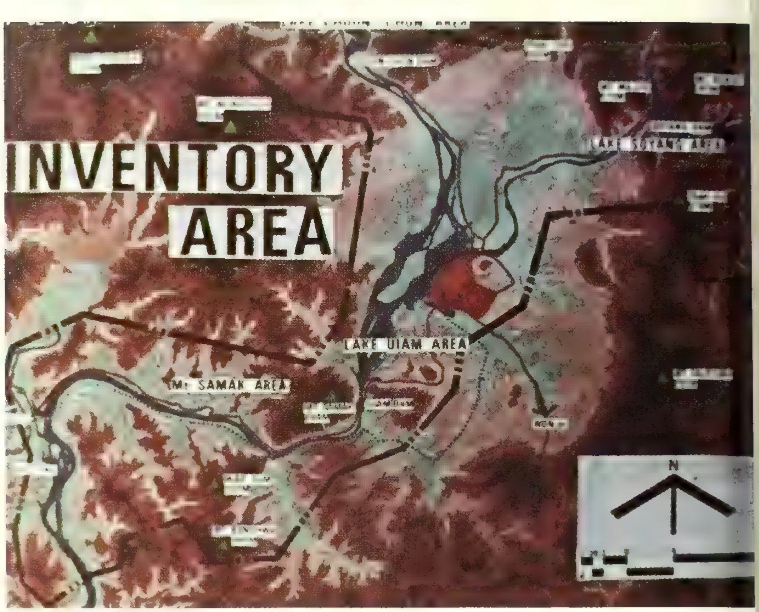

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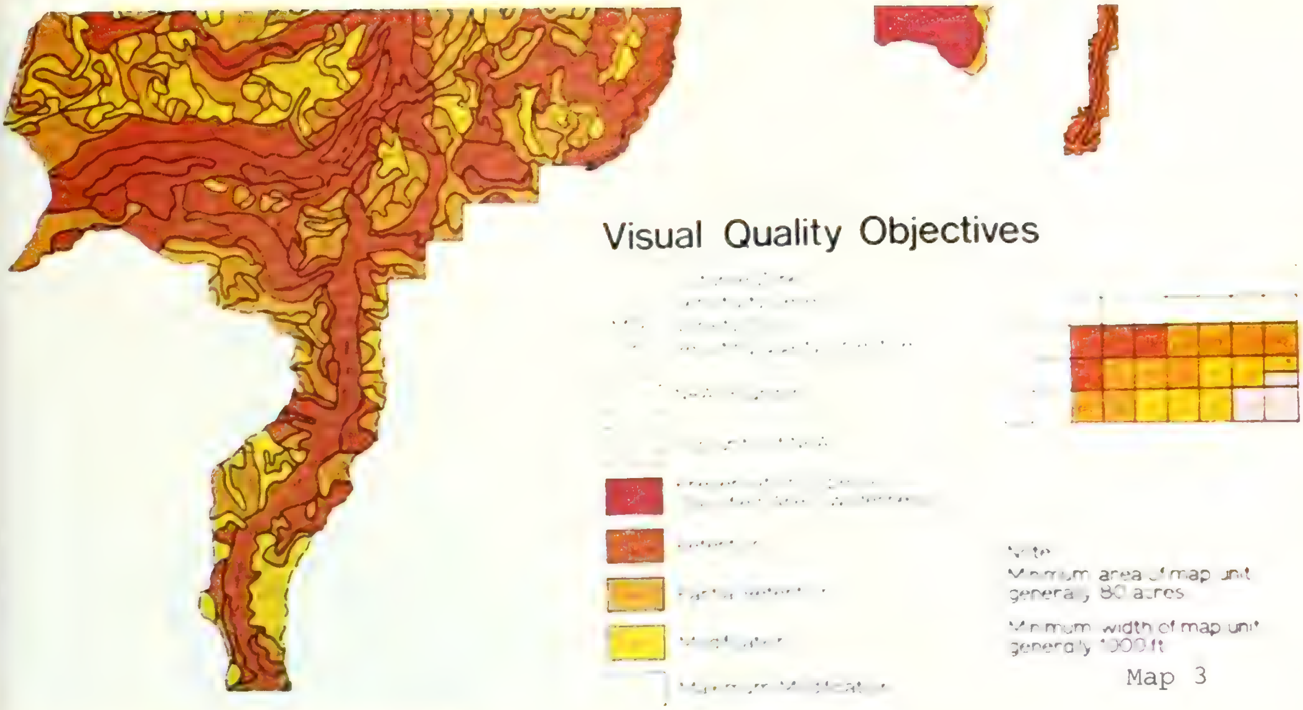
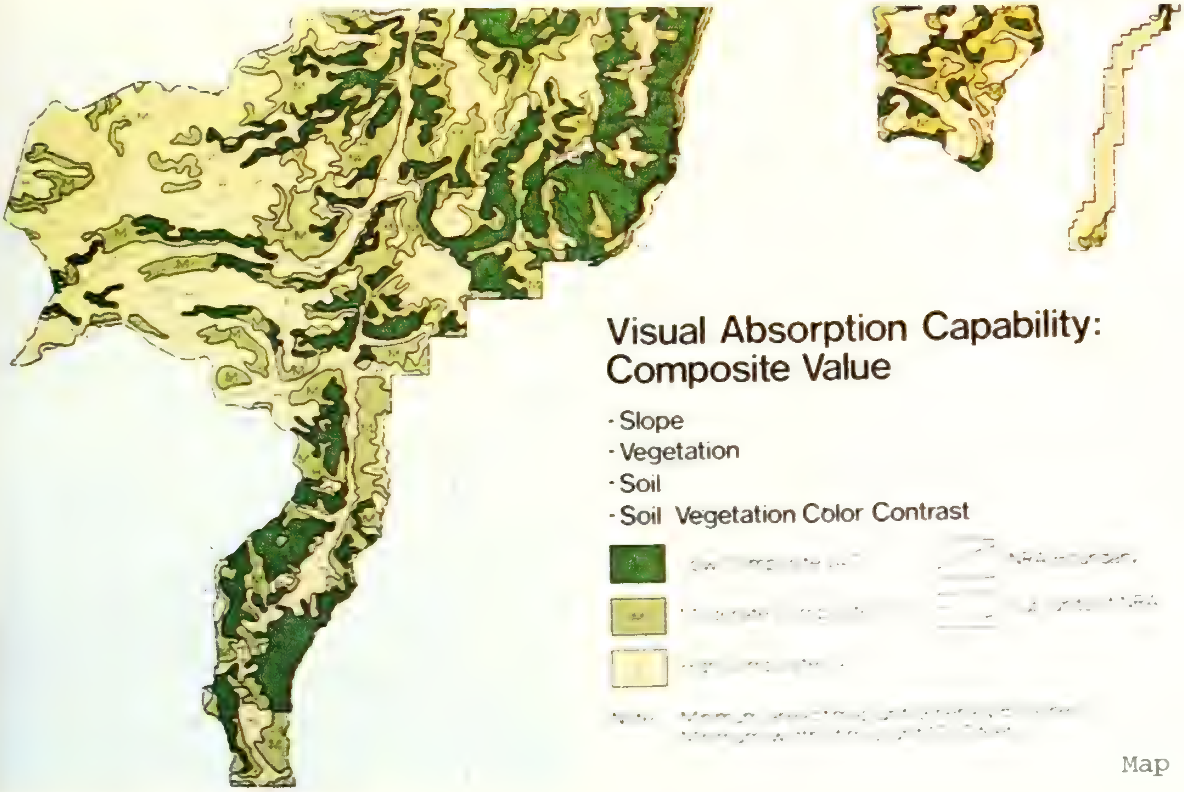
Suh: **Figure 1**—A drawing of Nation-wide tourism circle.
Figure 2—An inventory area.
Figure 5—A distant view of hillside and mountain peaks, towards Choon-Chon from the large and magnificent So Yang Dam.
Figure 6—A panoramic waterscape view, including Yanggu and Inje from the bank of So Yang Dam.


Visual Quality Objectives
Note
Minimum area of map unit generally 80 acres
Minimum width of map unit generally 1000 ft

Map 3

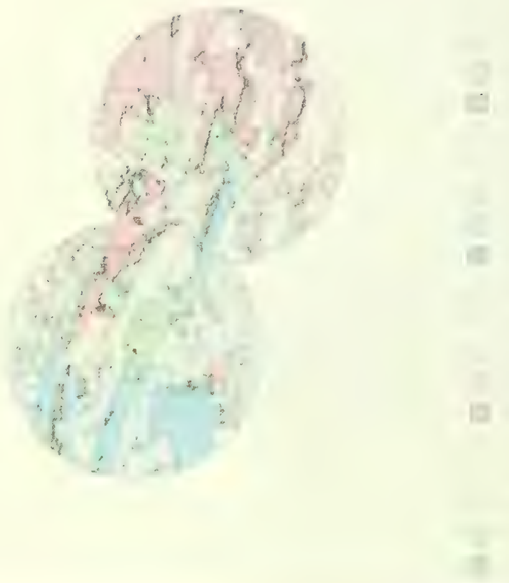

Visual Absorption Capability: Composite Value
· Slope
· Vegetation
· Soil
· Soil Vegetation Color Contrast

Map 4

Blau: **Map 3**—Visual quality objectives.
Map 4—Visual absorption capability: composite value.

Petrich: **Figure 2**—Study area defined by 5-mile radii around Cementon and Athens sites. Color indicates visibility to a cooling tower at either site, and shading pattern shows scenic quality of all land or water units. Darker shades indicate higher scenic quality.

Figure 5—*Winter Landscape from Olana* (c. 1870) by Frederic E. Church (1826-1900). Oil on paper, 11⅝ x 18⅛ inches. (By permission Olana State Historic Site, New York State Office of Parks and Recreation.)



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Treiman

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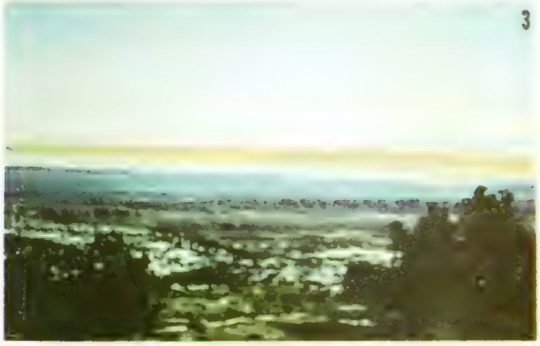
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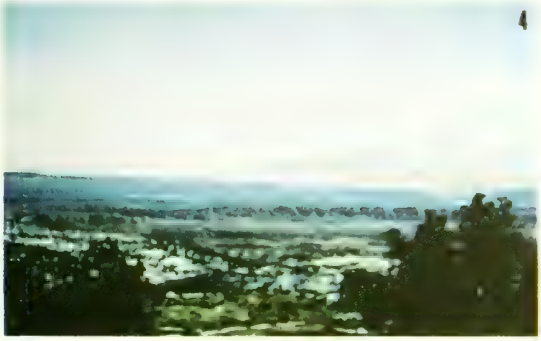
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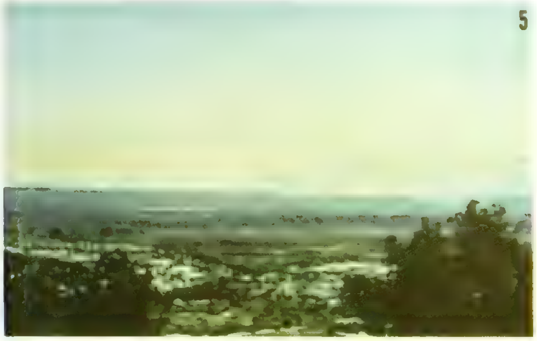
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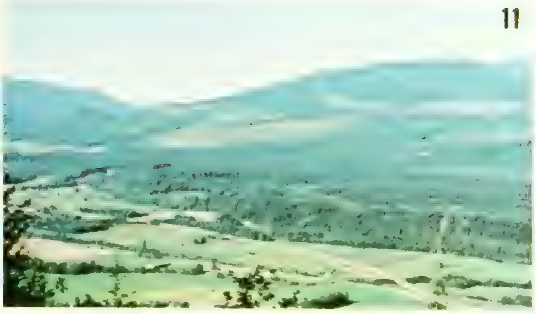
Treiman: **Figure 2**—Unaltered view east past Thompson Mesa toward the Henry Mountains on a cathode-ray tube (CRT).
Figure 3—Computerized (CRT) simulation of the plume expected from the single large plant under stable conditions.
Figure 4—Computerized (CRT) simulation of plumes from smaller plants.
Figure 5—Computerized (CRT) simulation of the plume from the 3000 MW plant with a neutral atmosphere.

Henley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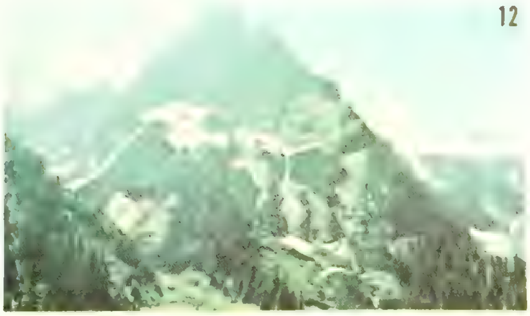
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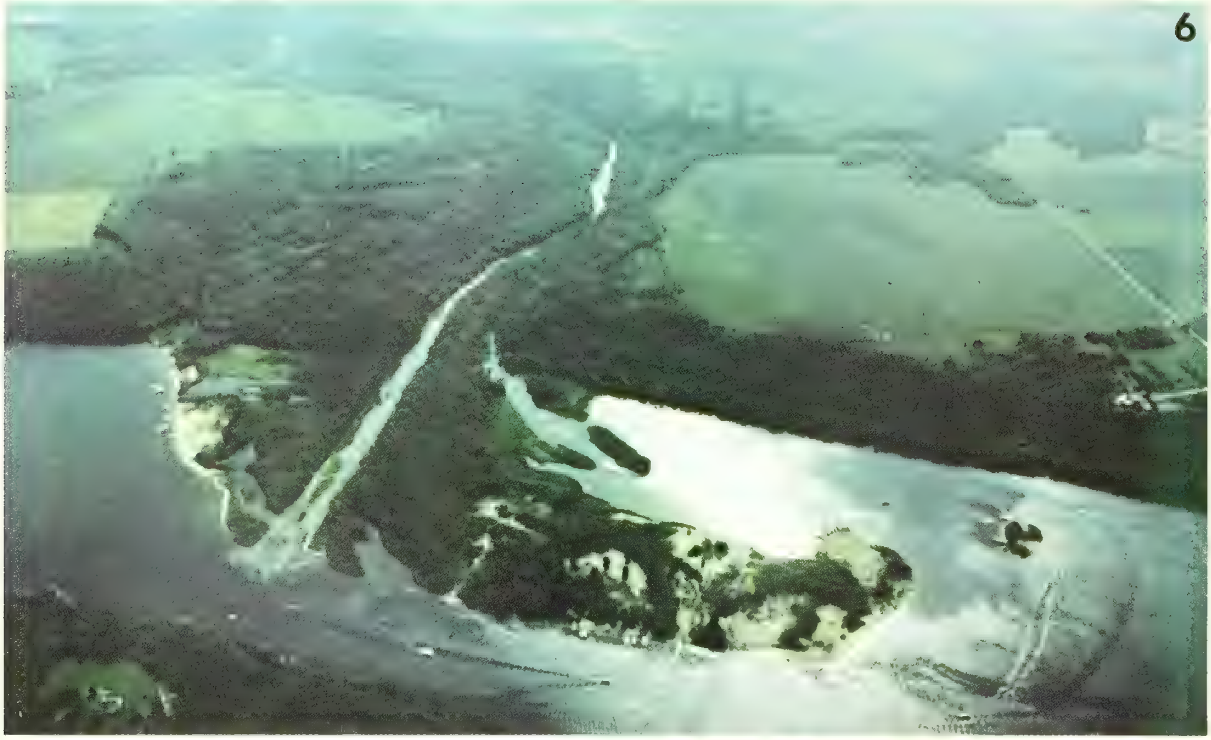
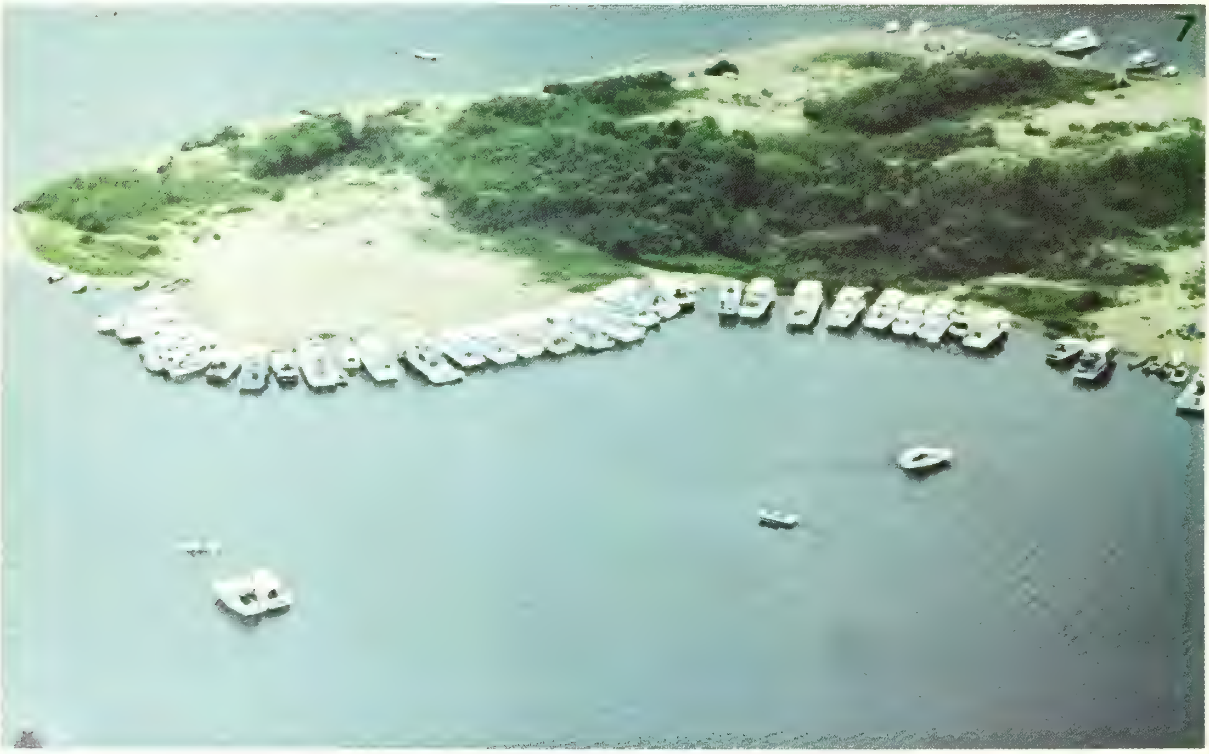
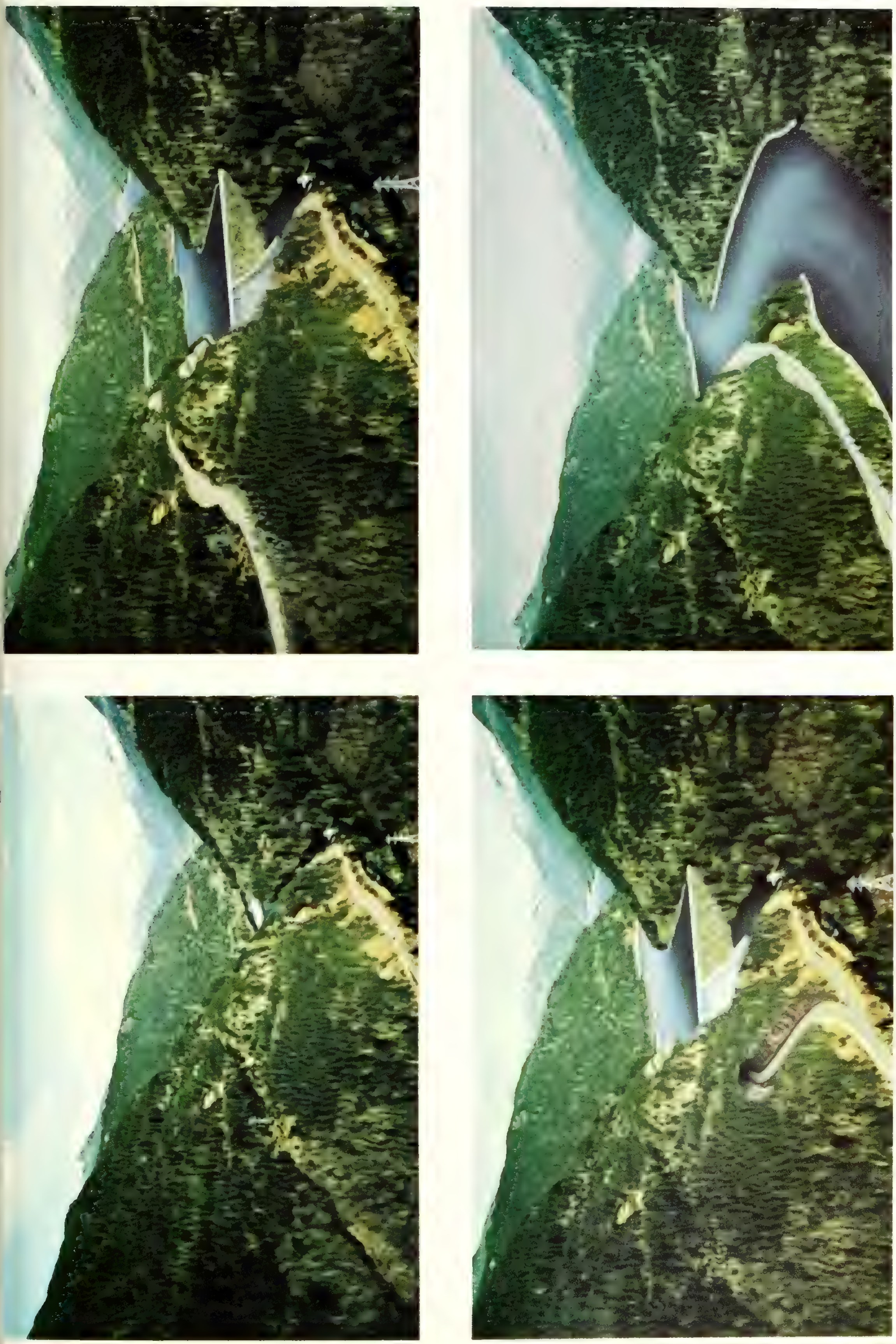
Henley: **Figure 11**—A representative scene of the broad Nooksack River valley framed by hills of low elevation.
Figure 12—An example of the narrow sections of the Nooksack River valley framed by steep mountain peaks.



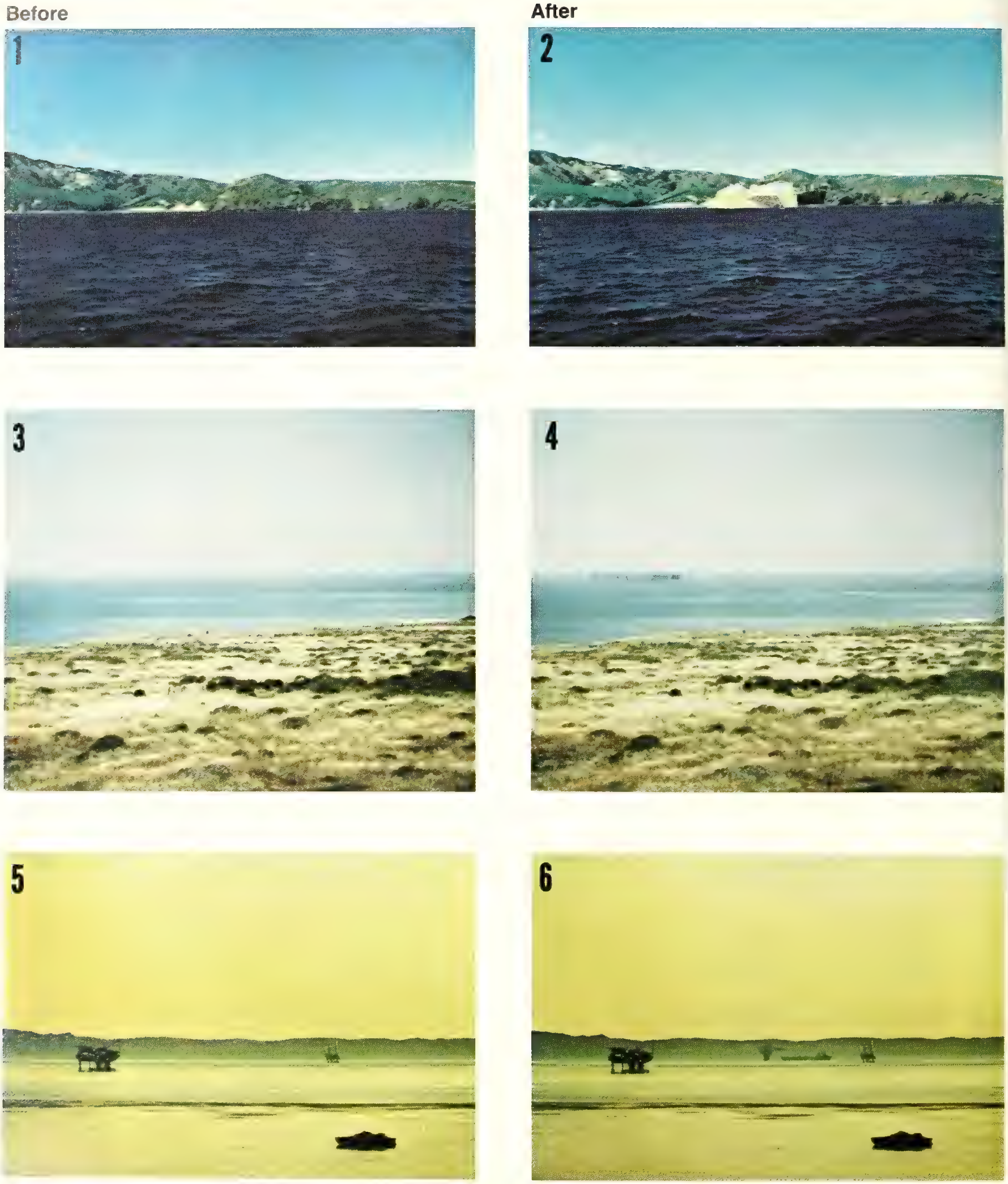


Becker: **Figure 6**—High oblique photograph of the Kinnickinnic River Delta State Park.

Figure 7—Low oblique photograph taken of the lower right portion of the Kinnickinnic Delta from the opposite direction of *figure 6*.



Ady: **Figure 6**—Four different alternatives simulated from the same view upstream from the Copper Creek dam site.



Baird Figure 9—Pre-impact scenes and post-impact simulations of (from *top to bottom*) Santa Cruz Island, Camp Pendleton, and Ventura Flats.

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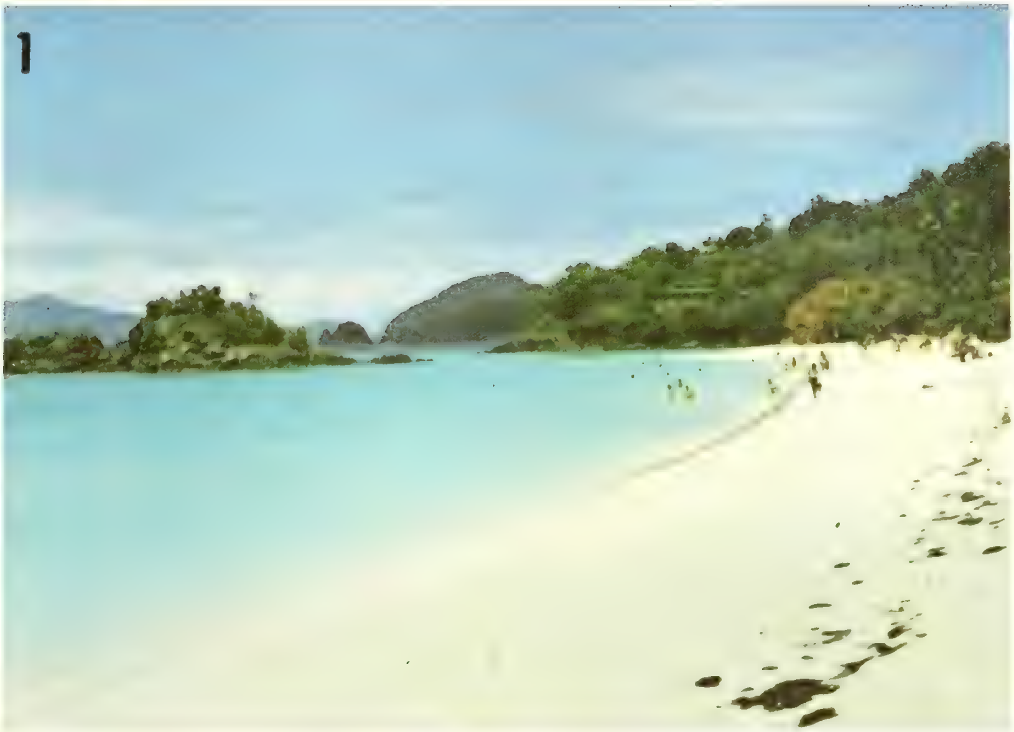

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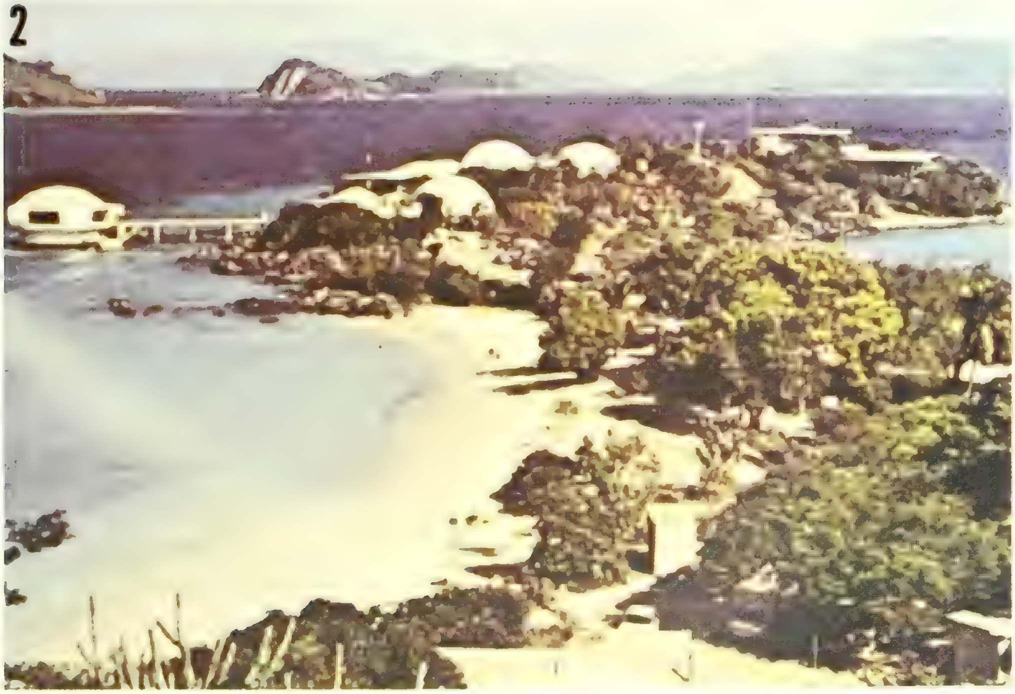

Mills: **Figure 1**—Site for the Trunk Bay Underwater Trail, St. John, U.S. Virgin Islands.
Figure 2—Coral World, Underwater Restaurant and Observation, Coki Beach, St. Thomas, U.S. Virgin Islands.

Appropriate Combinations of Technology for Solving Landscape Management Problems— Session G: Recreational Development

Does the Public Notice Visual Resource Problems on the Federal Estate?[1]

John D. Peine[2]

Abstract: Results of the 1977 Federal estate are highlighted. The survey of recreation on the Federal estate represents a unique data set which was uniformly collected across all Federal land managing agencies and sections of the country. The on-site sampling procedures utilized in this survey process have never before been applied on such a large scale. Procedures followed and lessons learned are featured together with survey results relevant to public attraction to visual resource quality and instances of landscape degradation.

INTRODUCTION

Visual resources are more and more becoming a part of our environmental ethic, and management of these resources is moving to the forefront. This conference on our national landscape is testimony to this. Unfortunately, this rising interest comes at a time when land management budgets are spread pretty thin. The public mood of tax limitation is accentuated by galloping inflation. As a result, most public land managers are being forced to decrease their management intensity.

This situation could be particularly detrimental to the subject at hand since the nonconsumptive visual resource has historically not received as much managment attention as the traditional consumptive resources such as timber, forage and water. As a result, land managers must make a case for the social value of quality visual resources. Simply to say that visual resources are more important now than ever before in this urban world in which we live might not be enough for a budget officer with a sharp pencil. But a demonstration of how visual quality significantly enhances the recreational experience might build a convincing case for its management.

Since visual resource quality is so subjective, the attitudinal survey is a particularly appropriate tool to measure (1) the social value of quality visual resources, (2) the public's perception of the severity of visual degradation and (3) the success of the management practices to alleviate visual intrusions. As in other areas of land management practice, on-site interviews are being used more and more to accomplish these goals. Public reaction to visual quality is best measured during experiences on the resource area in question. Other approaches such as recalling an experience or reacting in the abstract to visual stimuli, such as photographs, takes the visual resource out of context with the overall experience and invites potential distortion of opinion.

SAMPLING FRAMEWORK

In 1977, information relevant to assessing landscape problems was collected by the Heritage Conservation and Recreation Service (formerly Bureau of Outdoor Recreation) as part of a national survey of people recreating on Federal lands. The Federal estate encompasses one-third of our country's total land area. The study was confined to those Federal lands within the continental United States which are managed at least in part for public outdoor recreation activity. A total of 155 Federal areas were included in the summer interview period with a subsample of 35 areas used for the winter and fall seasons. A substantial amount of space in this paper is devoted to describing the sampling techniques, since the conference emphasizes descriptions of techniques used to measure visual quality.

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[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Outdoor Recreation Planner, Heritage Conservation and Recreation Service, Ann Arbor, Michigan 48107.

The sampling procedures utilized in this survey process have never before been applied on such a broad scale. A tremendous variety of circumstances was encountered by the 16-member survey team while conducting the personal interviews. For instance, while one interviewer was stationed at a trail head in the Bitterroot Wilderness Area managed by the U.S. Forest Service in Idaho, another was interviewing at New York City Gateway managed by the National Park Service.

Extreme climatic conditions were experienced over the three seasons and sections of the country but, because of the flexibility of the on-site sampling scheme, few days were lost due to inclement weather. Very high response rates were experienced at most areas. The overall response rate was 95.2 percent.

The effectiveness of surveys for assessing public awareness and perception of visual resource values and problems depends largely on the accuracy of the sampling scheme used to select respondents. Testing showed the 1977 national sample of recreators on the Federal estate to be well within conventional standards of confidence (95 percent confidence interval)[3]. Not enough interviews were collected at most areas, however, to allow for precise comparison between areas. The lessons learned from putting the sampling procedures to such an extreme test should be most helpful to land managers planning on-site surveys.

In order to draw a representative sample of recreation on the Federal estate, a random multistage probability system was employed. The first step required a scheme to choose specific management areas where the interviewing would take place, and the second step required a scheme for choosing respondents on the designated sites. The discrete land management units were stratified by sections of the country and administering agency, e.g., national parks for the National Park Service and national forests for the U.S. Forest Service. For analytic purposes, most of the areas were selected from the three largest providers of public recreation, i.e., National Park Service, U.S. Forest Service, and the U.S. Army Corps of Engineers. The number of areas chosen for the other four land managing agencies (U.S. Fish and Wildlife Service, Bureau of Land Management Bureau of Reclamation, and the Tennessee Valley Authority) was proportional to their annual visitation figures.

Within each Federal agency, land areas were then chosen at random with probabilities proportional to official yearly visitation statistics after first being certified as to the 10 Federal regions. Thus, a park with 2 million visitors annually had twice the chance of being chosen at random than a park with 1 million visitors annually. The use of systematic random sampling techniques with lists stratified by visitation and region ensured that the final sample of areas would be maximally representative of these characteristics in the population.

Once the list of areas was procured, an itinerary was drawn for each member of the survey team which established the order of interviewing and the number of days spent interviewing at each area. The interview time spent per area ranged from 4 to 18 days and reflected the relative annual visitation figures. The order of the summer itineraries was designed to ensure that all sections of the country woul be visited more than once during the summer.

The next stage of the sample scheme was to select respondents on the designated areas. Th primary objective of the on-site sampling schem was to collect interviews which accurately reflected the array of recreators utilizing the area. Another primary consideration was to interview people who had been recreating in the area long enough to offer opinions about operation and maintenance of facilities at the area. The roadside interview at exit points common to all area recreators was considered to provide the most accurate results to this end.

In order to facilitate the above concerns, the typical sampling plan during fair weather consisted primarily of roadside interviews alon exit routes during hours in which recreators were commonly leaving the area. During fair weather, periods when few recreators were leaving the area, interviews were conducted at sample points where recreation activity was likely to be concentrated: scenic overlooks, visitor centers, beaches, boat launches, trail heads, picnic areas and campgrounds. Time spent at all these sample points was approximately proportional to the percent of total area use occurring there.

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[3] Complete documentation of survey method and analysis is soon to be published by the Heritage Conservation and Recreation Service, Pension Building, Washington, D.C. 20243.

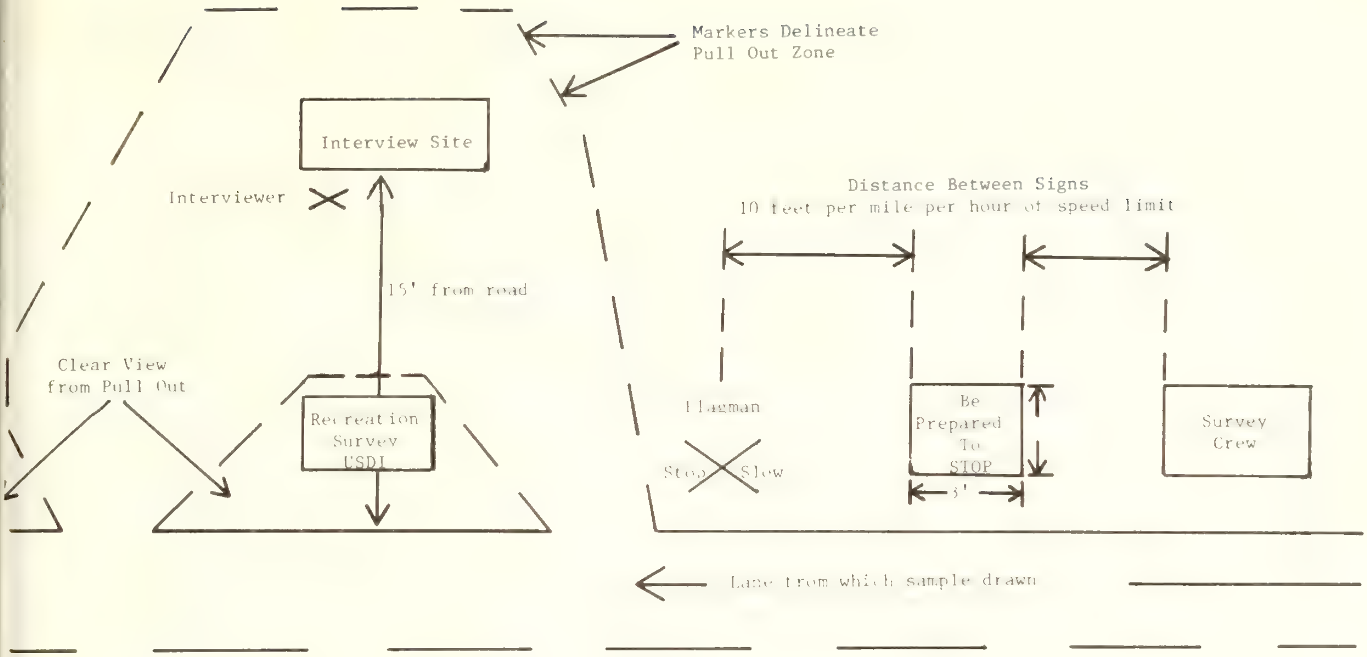

Figure 1--Roadside interviewing layout

A typical area, for example, might have three major access roads and four special facility areas such as a beach, boat launch, camp and picnic ground. If good weather prevailed for the duration of a 4-day interview period at this type of area, the interviewer would probably spend one morning at each of the four special facility areas (assuming each had a similar amount of visitation) and the four afternoons at safe locations along exit lanes of the three access roads. This assumes little morning traffic and equal recreation traffic volume on each access road. In cases where there were many more access roads or recreation facilities than there was time for them to be utilized, an attempt was made to devise as representative a sample as possible under the circumstances.

Figure 1 is a diagram of how a typical roadside setup was conducted. The potential respondent driving down the road first saw the "Slow" sign followed by the "Survey Crew" sign. Then an agency helper holding the "Slow/Stop" sign directed the vehicle either on past or into a special lane that was off the road and delineated by traffic cones. The interviewer stopped the vehicle within view of the "Recreation Survey" sign, proceeded to choose a respondent and conducted the interview. At that point, the designated vehicle had pulled well off the road. Notice the distances provided which are all important safety factors. In many states, permits have to be obtained for altering traffic flow. The survey team members had to repeat consistently the procedures designed to maximize safety. Because the survey team could not be supervised closely, this took personal conviction on the part of the interviewers. Thousands of people were stopped along roadsides without any accidents.

The general procedure for choosing a sample point at locations of concentrated activity (other than the roadside situation) called for the interviewers to position themselves at different points for each hour on the location. For instance, a beach scheduled as a 3-hour interviewing location might be divided mentally into three sections: where swimming was concentrated, where sunbathing was concentrated and where people strolled along the water's edge looking for shells. In the case of a campground, the area might be divided by loop drives or proximity to a scenic focal point.

The method for choosing a respondent once the interviewer was positioned on site was simply to approach the nearest person 12 years of age or older, or, when at a roadside, to stop the first car. If the nearest person was in a group, each member was assigned a number counting from left to right. For vehicles carrying more than one person, numbers were assigned to occupants from left to right as one faced toward the front of the vehicle, and front to back. The respondent was then chosen from the group according to a number from the random numbers table. Only one person was interviewed per group.

During inclement weather, alternative sampling points were available which provided adequate shelter from the elements for both the respondent and the interviewer. Appropriate facilities might include visitor centers, field offices, ranger stations, maintenance garages, or picnic shelters. When possible, facilities used were those where recreators would normally stop and visit, such as a visitor center. When no other alternatives were available, people would be asked to pull off the road and come inside to be interviewed. This approach was, of course, only applicable during relatively mild weather disturbances.

In all sampling circumstances, once on a sampling location, the interviewer would talk to as many people as possible. As soon as one interview was completed, another respondent outside the group associated with the previous respondent was immediately approached, using the described techniques.

The Federal estate survey was conducted by a team of 16 people employed by the Bureau of Outdoor Recreation. A week-long training session was held at the Smoky Mountain National Park to familiarize the team with the detailed procedures for choosing respondents and conducting the interviews. Once the formal instructional period was complete, each member of the survey team was given multiple opportunities to practice the sampling and interviewing techniques, first to other team members and then to the general public. Each practice interview, conducted at various roadside setups and facility developments, was critiqued by the survey coordinator and/or other members of the survey team.

Directions to the survey team could only be expressed as general principles or guidelines for devising specific sampling schemes. The directions could not be completely specific since each area had unique facilities and fluctuating use patterns. Obviously, personnel who developed the on-site procedures gained a thorough knowledge of the recreation facilities available and the recreational use patterns at each area. A checklist of information collected for each area was as follows:

1. Overall recreation use patterns--type of activity/location/percent total visitation/times of peak activity.
2. Access roads carrying recreation traffic--associated recreation facilities/time of peak exit traffic/relative volume of traffic flow.
3. Suitable roadside interview sites along the access roads.
4. Concentrated recreation activity--type of activity/location/facilities/percent of total visitation/times of peak activity.

Cooperation by managing agency personnel was very good. A substantial amount of their time was needed to convey information necessa to establish the sampling schedule. Agency personnel also helped control traffic and gui the interviewers to selected sample points.

The survey attempted to strike a good balance between principle and practice in order to develop a data base worthy of the survey's purpose and scope. Costs per interview for various aspects of the 1977 Federal Estate Survey process were as follows: $.22 to train interviewers, $7.28 to conduct inter view, $3.64 to code and analyze data, and $1. to report the findings.

The multistaged sampling design used in this survey was considered to be a self-weighted data base. The questionnaires were weighted to total population distribution because: (1) areas were chosen in proportion to their annual visitation, (2) more intervie ing time was spent at areas with higher visitation and (3) time spent at sampling points for each area was proportional to the percent of total area use occurring there.

In order to test the reliability of the self-weighted sample, two alternative weighting schemes were applied to the data: (1) by the number of people passing the sample point at the time of the interview period and (2) the total reported visitation for an area during the total number of days of interviewing. A portion of the sensitivity analysis comparing the self-weighted data with these two weighting schemes is shown in Table 1.

The single greatest statistical divergen between roadside and on-site interviews was f the expressed participation in sightseeing (11 percentage points difference). This is o of the few elements which might have logicall varied due to the fact that sightseeing is closely associated with vehicular traffic.

FINDINGS

Discussion of survey results presented i this paper is strictly limited to those results directly relevant to assessing visual quality. The key questions in the 1977 Federal Estate S vey relevant to visual resource assessment wer as follows:

1. Why did you choose to pursue these activities (identified from response to a previous question) at this area?

2. Have you been satisfied with your experiences during this visit to the area? Why not?
3. What improvements would you like to see made at the area?

Any reference to scenic beauty or visual degradation in the response to these open-ended questions was offered voluntarily by the respondents. No questions were asked which directly solicited public reaction to a specific visual resource condition.

The people who did cite visual resources in their response to these three questions were aware of the visual quality of the landscape. Managers of visual resources should be particularly interested in those recognizing visual degradation. These people provide important insight into the perception of visual resource problems. What appears as a serious visual degradation to a resource specialist may or may not concern the recreator. This perspective would be most helpful to the manager when balancing his financial and human resources between visual resources needs and other aspects of land management. It is, of course, inappropriate to take survey results too literally and make management choices according to their popularity.

Attraction for Scenic Beauty

Scenic beauty was cited by 1 in 5 Federal estate recreators as the reason for visiting an area. As shown in Table 2, visitors to National Forests were more likely to mention scenic beauty (24 percent) than those visiting areas managed by the National Park Service (18 percent). However, 25 percent of the visitors to major vacation-oriented National Parks (a subset generated from the Park Service sample) indicated scenic beauty was the main reason for their visit. Also, scenic beauty was cited more often (10 percentage points) in the western than the eastern regions of the United States. Three other categories of response to the reason-for-visit question which may have masked scenic quality elements were as follows: "repeat visit" (26 percent), "see specific object" (5 percent) and "group trip" (9 percent).

Table 1--Alternative weighting schemes for Federal estate data (figures given in percentages)

Sample Question	Response Category	People Weighted[1]	Property Weighted[2]	Self Weighted[3]
What is your age?	12-17 years	9	10	10
	18-24	17	15	17
	25-34	26	25	25
	35-44	20	19	19
	45-54	13	13	13
	55-64	9	9	9
	65+	6	6	6
How many years of education have you completed?	1- 8 years	8	8	9
	9-12	46	46	48
	13-16	35	34	33
	17+	11	12	10
Are you satisfied with your experiences here?	Yes	82	83	82
	No	3	5	4
	No opinion, just entered area	15	12	14

[1] Weighted by number of people passing the sample point during interview period.

[2] Weighted by total reported visitation at the area during the interviewing period.

[3] Reflects survey design and is used for all data presented in this paper. In this case, no weighting factor is applied to the data.

Note: Sixteen percent of those adults with up to 8 years of education chose to visit a Federal area due to scenic beauty.

Table 2--Reasons for choosing to visit a Federal area for recreation (figures given in percentages)

	Reason for Choosing Area	
	Facilities	Scenery
Managing agency of area:		
National Park Service	11	19
U.S. Forest Service	18	24
Fish & Wildlife Service	29	13
Corps of Engineers	33	15
Education of those at least 18 years old:		
Up to 8 years	30	16
9, 10, 11 years	27	16
12 years	22	18
13, 14, 15 years	20	20
16 years	17	22
17 and over years	16	21

The most striking socioeconomic relationship was comparing education level with the reason for visiting an area. As displayed in Table 2, the higher the level of education achieved, the more likely that "scenic beauty" and the less likely that "good facilities" were offered as the reasons for choosing the area visited.

Dissatisfaction With Visual Degradation

An overwhelming majority of the recreato on the Federal estate were satisfied with the experiences. Of those expressing dissatisfac 1 in 10 was concerned with the appearance of area (table 3). For the 11,549 interviewed d ing the summer survey season, only 50 people expressed dissatisfaction due to the area is ance and 11 of those were from one area. The response rate was too small to make socioeconomic comparisons.

These results should not necessarily be interpreted to mean that there are no visual resource problems on the Federal estate. Neither does it indicate public acceptance of existing visual resource conditions on the Federal estate. Different types of questions would have to be asked to measure public reaction to the condition of specific visual resources. What it does indicate is that few were dissatisfied with their entire recreational experience due to visual degradation o the landscape. An additional note of caution in interpreting the results is that the question dealt only in absolute terms. The degre of satisfaction versus dissatisfaction was no expressed.

Suggestions for Improvements of Visual Resour

Another way of assessing discontent with visual resources of the Federal estate was to study suggested improvements relating to upgra

Table 3--Dissatisfaction with recreation experiences on the Federal estate (figures given in percentages)

	Entire Federal Estate Population	Federal Estate Agencies			
		NPS	USFS	COE	FWS
Percent dissatisfied	5	3	6	6	11
Percent of dissatisfied users citing following reasons:					
Facilities	56	47	53	59	69
Appearance	10	11	9	10	8
Unruly visitors	7	3	9	8	6
Too expensive	2	3	2	2	2

Note: Dissatisfaction question not asked if respondent was just entering the area.

ing visual quality. As displayed in Table 4, more than one-half of the suggested improvements relate to facilities. People are more likely to offer opinions on facilities than the landscape. This may be due in part to the fact that the majority of recreation activities involves some type of facility. No significant correlation existed between activity participation or socioeconomic characteristics and suggested improvements in the national environment and, therefore, does not help in predicting who is the most likely to be concerned about visual degradation.

Suggestions for improving the natural environment relate primarily to visual quality and are more frequently mentioned at areas managed by the Corps of Engineers and U.S. Fish and Wildlife Service. Visitors to Corps of Engineers areas in Texas were the most likely to suggest improving the natural environment (10 to 30 percent). Examples of specific suggestions are provided in Table 5. Recreators living near the area visited are more likely than those driving farther distances to suggest improvements on the natural environment. Also, the more times people visit an area, the more likely they are to cite improvements in the natural environment. Therefore, areas with a large percentage of local and repeat visitors seem to be more likely to have a degraded scenic quality.

CONCLUSION

Results of the 1977 Federal Estate Survey suggest that scenic beauty is an important drawing card for recreational activity. A vast majority of visitors are generally satisfied with their recreational experiences. Only a few express overall dissatisfaction with their recreational experiences due to visual degradation of the landscape. On the other hand, apparently 1 in 10 suggests improving the natural environment of the Federal estate.

The methodology to conduct this type of effort is generally transferable to area managers. Key skills which should be centralized are the training of interviewers and the analysis and detailed interpretation of results. The principles followed in the sampling design are applicable to any area. The primary critical element up to the discretion of the land manager is the desired reliability of response. The relationship between cost of data procurement versus the value of precise reliability must be carefully studied.

Table 4--Suggested improvements on the Federal estate (figures presented in percentages)

Suggested Improvements	Entire Federal Estate Population	Federal Estate Agencies			
		NPS	USFS	COE	FWS
Leave area as is; no improvement necessary	41	48	40	34	39
Increase type and/or number of facilities	38	29	39	46	39
Maintenance of area	7	5	9	7	10
Improve natural environment	8	5	5	13	13
Improve signs	2	3	4	1	2
Limit number of visitors	1	2	1	1	*
Improve policing of area	3	2	5	3	1
Fewer rules and regulations	1	1	1	1	2
Provide more information to visitors	1	2	1	*	1
Dissatisfied with fee structure	1	1	1	*	1

Note: Questions not asked of people just entering the area.
* = less than .5 percentage points.

Table 5--Improvements suggested for selected Federal estate areas

Agency	Name of Area
National Park Service	
Cut shrubs that obstruct view	Acadia N.P.
Clean up the cans upriver	Amestad N.R.A.
Too much trash, clean up area	C & O Canal N.H.P.
Open up more scenic area to vehicle access	Dinosaur N.M.
Clean litter in canals and bays	Everglades N.P.
Better identification of natural features	Glacier N.P.
Limit commercialism on outskirts of park	Glacier N.P.
Make people bring back garbage instead of burying it because the water rises and uncovers it.	Glen Canyon N.R.A.
Bike lanes where you can see the canyon	Grand Canyon N.P.
Identification of what you are seeing from the various overlooks	Great Smoky Mtns. N.P.
Cleaner beach	Indiana Dunes N.S.
U.S. Forest Service	
Clean up forest area near the roads and save the pine trees from dying	Bridge - Teton N.F.
Better public education of campers/picnickers to take pride in this area	Coronado N.F.
Eliminate clear cutting from the forest	Florida N.F's.
Trim dying trees and selective timber cutting	Galletin N.F.
Understory cut back near water	Mississippi N.F.
Cut dead trees on the beach and the large white pine in center of beach	Nicolet N.F.
Litter at Jefferson Lake	Pike N.F.
Corps of Engineers	
Would like to see it kept as wild as possible	Allegheney River System
Keep water level stabilized	Arkabuta Lake
Demolish concrete beach and replace it with sand	Beaver Lake
Get stumps out of water	Benhook Lake
Place has been overdeveloped	Canton Lake

Landscape Assessment for Tourism[1]

Clare A. Gunn[2]

Abstract: Increased development of landscapes for tourism now creates problems of integrating the many parts. Accomplishments at the site scale have not been matched with equal progress at the regional scale. This concept, and its example of application, shows promise of assisting regions in assessing their potential of landscapes before development. With such a concept, not only do regions have better guidelines for developing or protecting resources, but also the many developers can make more effective decisions at the site scale.

INTRODUCTION

The intent of this paper is to describe a new concept for assessing the national landscape for tourism development and to illustrate its application. At no time in history have as many lands been put to tourism use and yet the traditional approaches of haphazard exploitation of landscapes continue.

For purposes here the landscape of tourism is defined as the total physical and visual environment utilized by all tourism activity. It includes the whole of tourism development, such as transportation, services, information, direction and all the developments that attract people and give the incentive as well as the satisfaction to travel.

THE CONCEPT

This concept is based upon the following sequence of assumptions or premises:

1. Tourism development is most frequently promoted because of its economic impact, derived through service businesses and facilities.
2. These service businesses depend upon flows of tourists who seek things to see and do--attractions, such as parks, recreation areas, commercial attractions and events.
3. Attractions are primarily physical landscape developments that have been selected, designed and managed by a variety of specialists, owners and managers.
4. Attractions and many other important tourism developments depend, in varying degrees, upon both physical and program factors.
5. When these factors are identified, described and mapped, better assessment of future policy decisions can be made at both the regional and the site scale.

In other words, this concept goes beyond the popular belief that all land has equal potential for tourism development if promoted heavily enough. While promotion is an essential and well-exercised factor of contemporary tourism, other elements, such as the foundations of things to be developed and promoted, accessibility and location of prime service centers, are equally important. Land is not homogeneous. Certain lands have much greater strength of factors in the support of potential tourism than others.

Certain physical factors (Table 1) were derived from examining the range of tourist activities generally and the extent to which their development depends upon physical conditions. While tourist activities vary, for a culture and for a given time period, they can be typified and generalized.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Professor, Recreation and Parks Department, Texas A&M University, College Station, Texas.

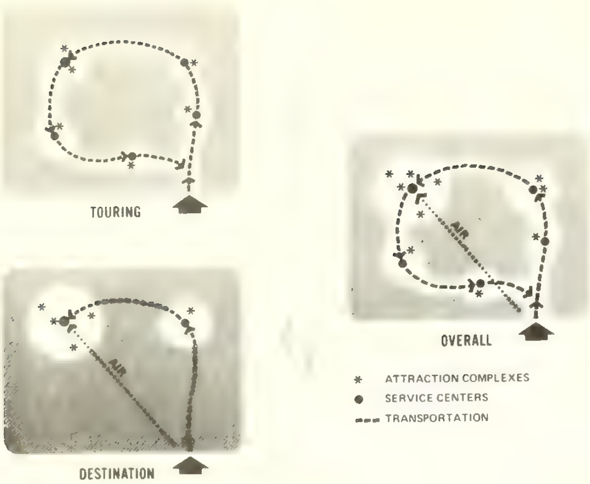

Figure 1--*TOURING AND DESTINATION TOURISM. Diagrams showing touring and destination type zones for tourism development and their combination for overall potential.*

To these must be added program factors, such as the following: (1) markets, promotion; (2) information, direction; (3) socio-environmental; (4) implementing agents.

Another element of this concept is recognition of the difference between touring and destination tourism. Touring tourism development does not need to withstand repetitive use by the same users. Visiting historic sites, natural resource attractions and enjoying roadside scenery are examples of touring tourism. For destination tourism, however, development requires a set of activities at attractions that are repetitive and more limited to a localized vicinity. For example, conventioneering, resorting, vacation home use and organization camping require slightly different attraction development and foundation factors. Figure 1 illustrates the concept of identifying zones suited to touring and destination tourism development and combining them for overall potential.

Table 1--*INDEXES FOR TOURING TOURISM*

Factor	Index
1. Water, waterlife	8
2. Topography, soils, geology	10
3. Vegetative cover, wildlife, pests	7
4. Climate, atmosphere	3
5. Esthetics	13
6. Existing attractions, industries, institutions	10
7. History, ethnicity, archeology, legend, lore	9
8. Service centers	15
9. Transportation, access	25
	100

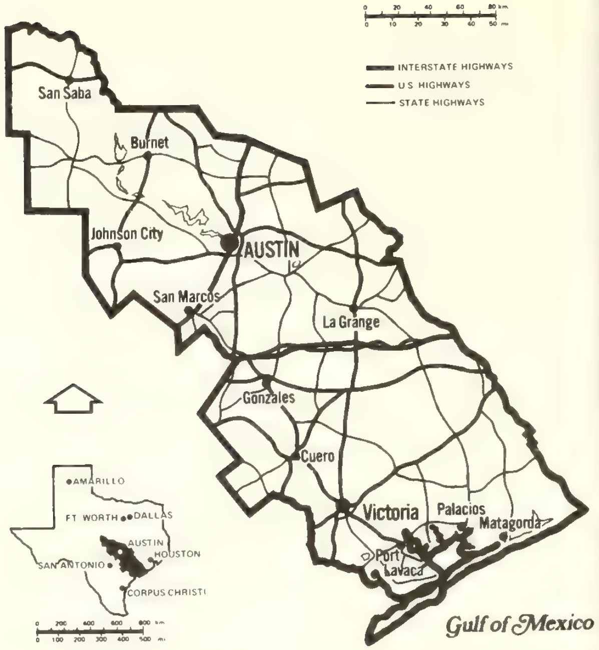

Figure 2--*THE STUDY REGION. The 20-county region of Texas used in this application of a concept for assessment of tourism development potential.*

APPLICATION

A region of 20 counties in south-central Texas (Figure 2) was arbitrarily selected for application of this concept.

The first step consisted of researching the region's physical factors. By means of

Table 2--*INDEXES FOR DESTINATION TOURISM*

Factor	Index
1. Water, waterlife	24
2. Topography, soils, geology	10
3. Vegetative cover, wildlife pests	8
4. Climate, atmosphere	13
5. Esthetics	7
6. Existing attractions, industries, institutions	5
7. History, ethnicity, archeology, legend, lore	3
8. Service centers	10
9. Transportation, access	20
	100

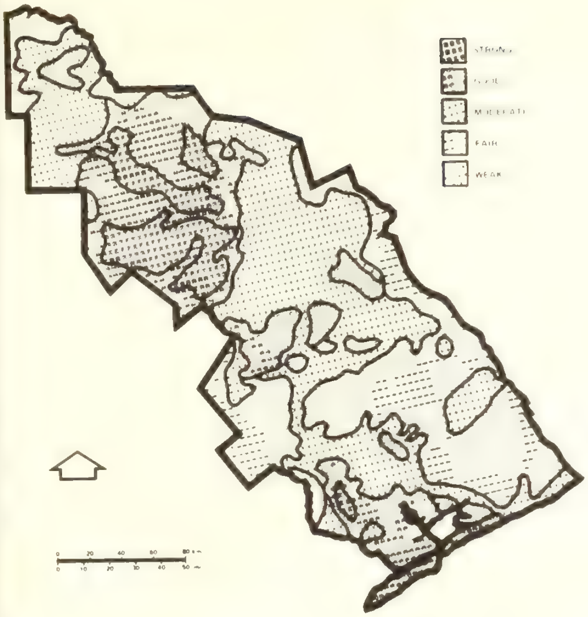

Figure 3--*"TOURING" TOURISM--PHYSICAL FACTORS. Computer printout showing areas with strongest to weakest resource strength in support of touring tourism development.*

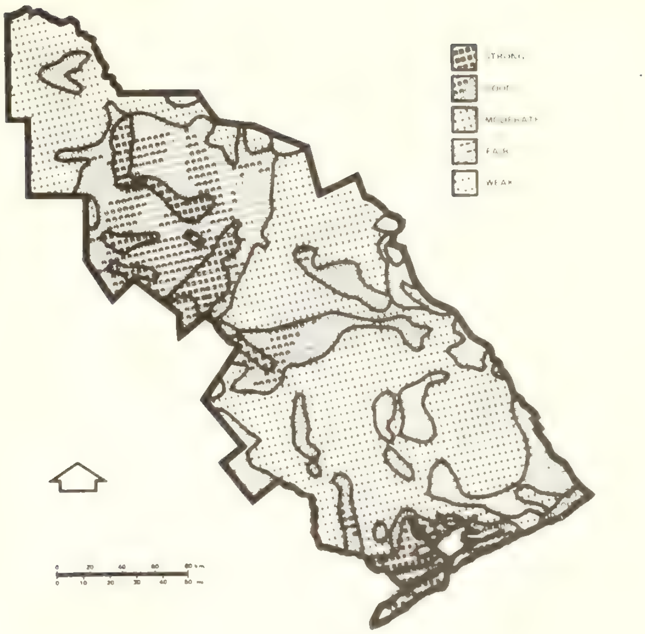

Figure 4--*"DESTINATION" TOURISM--PHYSICAL FACTORS. Computer printout showing areas of strong to weak support of destination tourism development.*

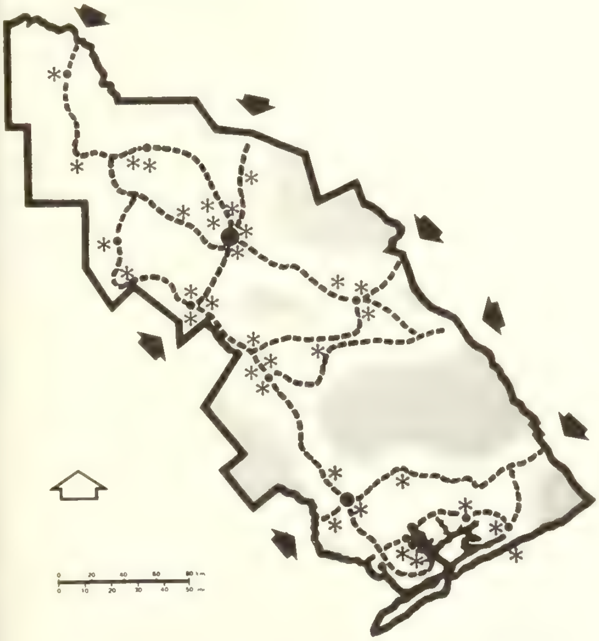

Figure 5--*"TOURING" TOURISM--CONCEPTS. Potential zones for development, containing locations of possible attraction complexes, service centers and proposed touring routes. Arrows indicate prime entrance points.*

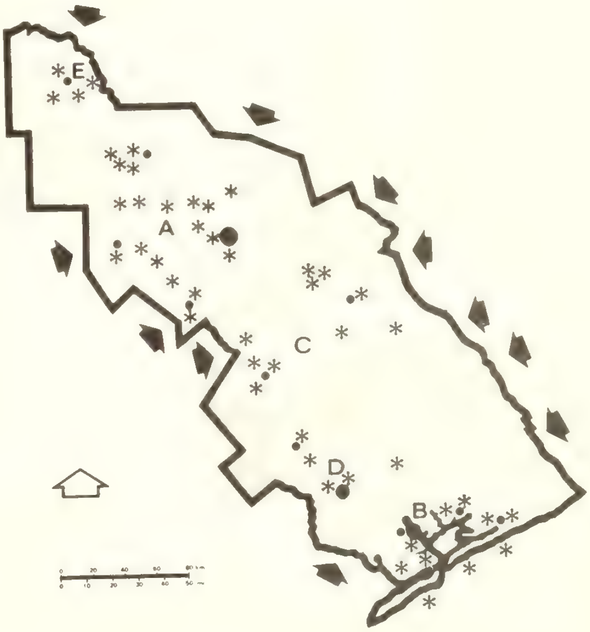

Figure 6--*"DESTINATION" TOURISM--CONCEPTS. Potential zones for development, containing locations of possible attraction complexes and service centers. Arrows indicate prime linkage with market areas.*

study of documents, reconnaissance of the region and interviews with experts, both narrative statements and maps were produced. Special mapping procedures were used to lay the foundations for the zones with greatest potential.

Tables 1 and 2 indicate a separate weight, or "index given to each physical factor, based on the assumption that these factors are not of equal weight in support of either touring or destination tourism development. These weights were developed by a panel of experts. Obviously, this is a subjective evaluation but based not upon whim or local pride but upon documentation of facts about each factor. For mapping purposes, each index was divided into five levels of potential support, from "strong" to "weak." The resulting number values could then be used in preparation of a hand-drawn map for each factor.

The several hand-drawn maps were then translated into computer maps so that they could be aggregated. Aggregated maps for touring tourism potential and destination tourism potential are shown in Figures 3 and 4, respectively. Wherever the totals were the largest, the strength of support of tourism development would be strongest. By using a computer map grid for the SYMAP (Dudnik: 1971) program, each cell for the scale of map used represents 6.25 square miles.

Study of both the research information about all factors and the results of computer mapping provided locational conclusions about what kinds of development had potential and where such development most logically could take place. This final assessment is illustrated in Figures 5 and 6. Graphically, four main elements are illustrated: zones with highest potential (white areas); locations with high potential for future attraction complexes (stars); key community service centers (dots) and transportation and access (arrows and dash lines).

Touring Tourism

It was found that several zones (Figure 5) contained many assets for potential touring tourism development. In most instances, no development had yet been made at historic points of interest with the potential of large and very meaningful complexes. Developing museums, restoring buildings, adding pageantry nearby, and identifying historic sites and buildings could offer opportunities for loop walking or drive trails and holding special events in squares, malls or parks. Interesting land features, such as reservoirs, rivers, isolate forests, beaches and coastal resources provid many opportunities for touring tourism activi development.

Wherever there appeared to be a grouping of these attraction complex potentials around a service center and near a circulation corridor, a zone was identified. This is merely a generalized area in which a number of complexes could be developed and served by the same service center and access.

Because of the importance of the travel ways of touring, all transportation corridors, when finally selected, would need to be studie and possibly redesigned to fulfill tourism functions. This might require very little re-development--perhaps only some signage and improved information-direction material. On the other hand, major cleanup, scenic easements, new highway design, expanded service center functions (toilet facilities at rest stops), new landscape plantings and the installation of certain constraints against public trespass along the way may need to be initiated. For air travelers, new linkages with ground tour corridors may need to be created.

Service centers were chosen on the basis of their own existing service capability, thei potential for expanded service, their proximit to potential attraction complexes and their ac cessibility.

Destination Tourism

For destination tourism, shown in Figure 6, this region has good highway access and som air access to existing and potential markets. The following five destination zones contain cohesive resource foundations lending themselv to considerable future tourism development.

Zone A contains potential for vacation ho complexes, resorts, dude ranches, organization camps, water sports areas, conference centers and major sports arenas. The hills, lakes, topography, history and state capitol combine to provide strong foundations.

Zone B, a coastal area, has great potenti because the resource assets have not yet been developed to a very large extent. Increased development to utilize the birdlife, waterlife, waterfront forces, biological production in th estuaries and geological formation of barrier islands has many possibilities. Large nature interpretive complexes could provide an important tourist function, leaving extensive areas in protected zones for preservation of natural ecosystems. Other potential lies in the festivals, pageants, historic restoration and interpretation of the coast.

Zone C is well suited to inland Texas tourism development, such as dude ranches, resorts and special development around the German and Czech themes. Market sources are generally available, accessible over good highways and the service centers are beginning to orient themselves toward tourist development.

Zone D is a coastal plains destination area with the city of Victoria and the Guadalupe and Lavaca Rivers as prime assets. Opportunities for camping, vacation home, water recreation and conference activities can be found here. The countryside is picturesque and the outside markets would find it a zone much more interesting and appealing than the typical Texas image.

Zone E, although relatively small, does have potential centered on the natural resource assets of river valleys. Camping and vacation home complexes could offer interesting vacations for many and are readily accessible from markets.

Program Concepts

Although not lending themselves as well to mapping, researching program factors led to conclusions important to development potential.

One conclusion centered on the need for greater education on several facts of tourism development. Some of the prime businesses oriented to tourism were aware of its impact but tourism does not now enjoy a high level of understanding within the region. For example, it is not well known that in these counties there is now an economic impact annually of $307,692,700, employment of 2,000 people and returns to local taxes of $3,116,800. (The Impact 1978).

Both nearby and distant markets might be cultivated but only following coordinated development-promotion-information programs. This is not now available for these zones. Special market interests could be emphasized: spring and fall offer idyllic vacation settings. Detailed market studies of the special opportunities within this region could be of value.

Improved information and communication offer other opportunities. Even existing attractions and services are not well communicated to the visiting public. It is not easy for the visitor to learn about points of interest, travel ways, accommodations and specialty shops.

If the concepts of physical development are to be realized, it is clear that stronger organization to stimulate development is needed. In several instances, industrial development is promoted but no comparable programs for tourist development can be found.

Linkage needs to be established between the many forces fostering resource protection and restoration and the developers of tourism. While there is a functional spinoff from such programs as historic restoration, there is no organized linkage with the programs of inviting and providing services to visitors.

The physical development of tourism could be enhanced if greater coordination of decision-making could be accomplished between the several state agencies that impact on tourism. Without creating new and cumbersome bureaucratic procedures, there is merit in agency input to each other on tourism matters.

Another important level of communication and decision-making is that between counties. Perhaps through leadership and catalytic action of the councils of government, the several counties of each potential zone can bring the several opportunities into alignment and implementation.

Finally, linkage between public policy on park and recreation programs and decisions on commercial development of tourism is a great opportunity for improved tourism. One major new policy of all public agencies could be to stimulate innovative and environmentally sensitive development by the private sector.

DISCUSSION

This approach to the assessment of the landscape for tourism development raises issues of both methodology and implementation.

The acts of participation by tourists at attractions are extremely varied and difficult to classify. The only classification used here is that of two categories: touring and destination. Another typology might include the five categories of sightseeing, outdoor recreation, vacation homes, conventioneering and attending events. Whatever typology is used at the regional scale, it should be comprehensive. In any case, the process described here will apply. It merely requires the development of more indexes for the quantitative scaling to be used on the several computer maps. It should be kept in mind that the end product involves total tourism development, not fragments. The components of transportation, services and facilities depend upon volume. Therefore, it is necessary to look toward zones best served by these. This demands aggregation of potential derived by grouping together the many separate activity potentials.

Because overall tourism development does include many factors, an essential component of strategy is involvement. It should not be construed that the concept described here is merely a drafting room technique to be implemented by an elite of landscape architects. On the contrary, unless there is commitment by the existing tourism establishment, developers, investors, citizens who may be impacted by tourism and the many governments involved, the concept would be of little value. It should be emphasized that economic expansion, although a virtuous objective, is not the only goal of this concept of landscape assessment. In fact, the three goals must be sought at the same time: improved visitor satisfaction, better business and improved environmental use and protection.

A basic assumption requiring deeper research is that concerning the physical and program factors required for tourism. Observation and location theory formed the basis for this concept. Yet, much deeper study is needed to determine those factors needed for success for both the developers and the users. While some studies in marketing and psychographics of travelers are increasing our knowledge of tourist behavior, much more information is needed. While location theory has been developed for industry, little is known about the geography of tourism. The development of this concept exposed the real need for greater understandings of resource and development linkages, such as the relationships between parks, commercial attractions, historic sites and the several services and facilities.

Study for this concept revealed a great amount of polarization between supporters of development and conservation, with landscape assessment schemes often aligning behind conservation. While such polarization of these ideologies is understandable it tends to exacerbate rather than solve problems of resource development. Instead, there is evident need for much more cooperation and collaboration between all who design, develop and use the landscape. So-called "capacity" problems appear to result more from poor landscape design, utilization and management than from overuse.

CONCLUSIONS

It is possible and also helpful to make a generalized landscape assessment of a region for tourism development with the aid of computerized techniques. This provides landscape planners, governments, developers and existing tourism development a perspective on land area with greatest potential.

The process described here is highly dependent upon commitment of local and state governments and other prime factors. It is limited by the extent of research knowledge concerning the linkage between resource assets potential use and development.

This approach leads up to and provides th basis for site design and feasibilities of individual projects for tourism. By identifying potential, local decision-makers and planners can weigh their further action toward both protection and development.

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NOTE:

The concept described here and the illustrations are from the book, TOURISM PLANNING by Clare A. Gunn, published by Crane, Russak, Inc., New York.

Assessment of Visual Resources Desirable for Tourism and Recreational Uses Along the Site of Lake Choon-Chon in Korea[1]

Won-Woo Suh[2]

Abstract: This paper describes the inventory and analysis of visual resources in the Choon-Chon lakeside tourism route between the Seoul tourism circle and the Seolag tourism circle. The study was a service requested by the Korean Society of Landscape Architects under supervision of the Tourism Department of the Kang Won Provincial Government Office, Republic of Korea. It reflects the sightseeing and recreation center of this area in assessing its scenic value. Accordingly, the area that was inventoried and analyzed included about 92 km^2 (Mt. Sam Ack district, Ui Am lake district, Choon-Chon lake district and So Yang lake district) reaching So Yang lake and the upper coast of north river Han within a visual corridor (Litton 1968) northeast from Seoul. The result of the inventory and analysis was outlined as follows: First, the unpolluted and calm water scene was characterized. Second, graceful and sublime mountain peaks' scenery includes rivers and lakes to provide contrast (USDA 1973) and can be reached by several mountain roads. Third, they can be developed for tourism (Korean Landscape Development Corp. 1975) of a dynamic nature. Fourth, the area has an unpolluted and pure natural environment.

INTRODUCTION

Objective of the Study

The Choon-Chon Area provides graceful mountain peaks, well-wooded scenery (Litton 1968), clear and peaceful rivers and lakes, a majestic dam, historic temples, relics, and abundant scenic resources. This area is located about 120 km northeast of Seoul (fig. 1*) with an inconvenient road access (fig. 2*). So far, the visual resources throughout this area have not been developed and utilized, but have been inventoried and analyzed, and the scenic value preserved. In order to develop and utilize this resource, this study aims to recommend a nation-wide circulating tourism system in relation to the Seoul tourism circle with Seolag tourism circle (National park of Mt. Seolag).

Scope of the Study

The areas of this proposed plan are centered around the Choon-Chon area and the visual corridors are distributed linearily along the upper-coast of the north river Han. The topography and dam are its boundaries. The total area is divided into four areas including: 1) Namisum Island and Kangchon Bridge from Seoul which is called the Mt. Sam Ack district, 2) all districts covering Choon-Chon city from Ui Am Dam which is called the Ui Am Lake district, 3) the north district from Choon-Chon city which

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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*See color illustration on page 392.

Table 1--Specifications of the Reservoirs

Dam Sources	Choon-Chon Dam	Ui Am Dam	So Yang Dam
Stream dimension (km^2)	3,901	7,765	2,703
Floor level (EL, m)	104	73,360	198
Ordinary filled Water level (")	103	71.50	193.50
Maximum level (")	98	66.30	150
Quantity of reservoir (m^3)	1.5×10^8	0.8×10^8	29×10^8
Acceptable quantity of using: (m^3/sec)	131.30	71.00	304

Table 2--Assessment table based on valuation, perception and resource values.

	Area Criteria	Mt. Samag	Lake Ui Am	Choon-Chon Lake	So Yang Lake
Landscape value	Historic value	numerous	numerous	scarce	numerous
	Fair land	scarce	numerous	scarce	scarce
	Economics & Social values	scarce	numerous	scarce	numerous
Landscape perception	Aesthetic factors	form, line, color texture	line, color	form, color texture	form, line, color texture
	Characteristic[1/] landscape	feature & panoramic	water-scape	water-scape	panoramic water-scape
	Diversity	numerous	numerous	scarce	scarce
	Native fancy	numerous	scarce	scarce	numerous
Landscape resources	Scale	large	wide	small	large
	Hydrology	scarce	numerous	numerous	numerous
	Forest resources	numerous	scarce	numerous	numerous
	Temples	existed (1)	none	none	existed (1)
	Historic place	numerous	scarce	scarce	numerous

[1/] After Litton 1968.

landscape and legend. The assessment (see tables 1 and 2) takes landscape values, perception and resources into consideration.

From the assessment in the previous tables, the character of tourism and recreation for Choon-Chon lakeside area is summarized as follows:

Mountain Samag Area

This area offers mountain climbing, golfing, lawn-skiing, picnicking, camping, an archery site, and waterside camping (coast of Kang Chon area).

Lake Ui Am Area

On Chung Island and Sand Island area are the lakeside of fantasy, sandy beach of adventure, future world and hill of tradition).

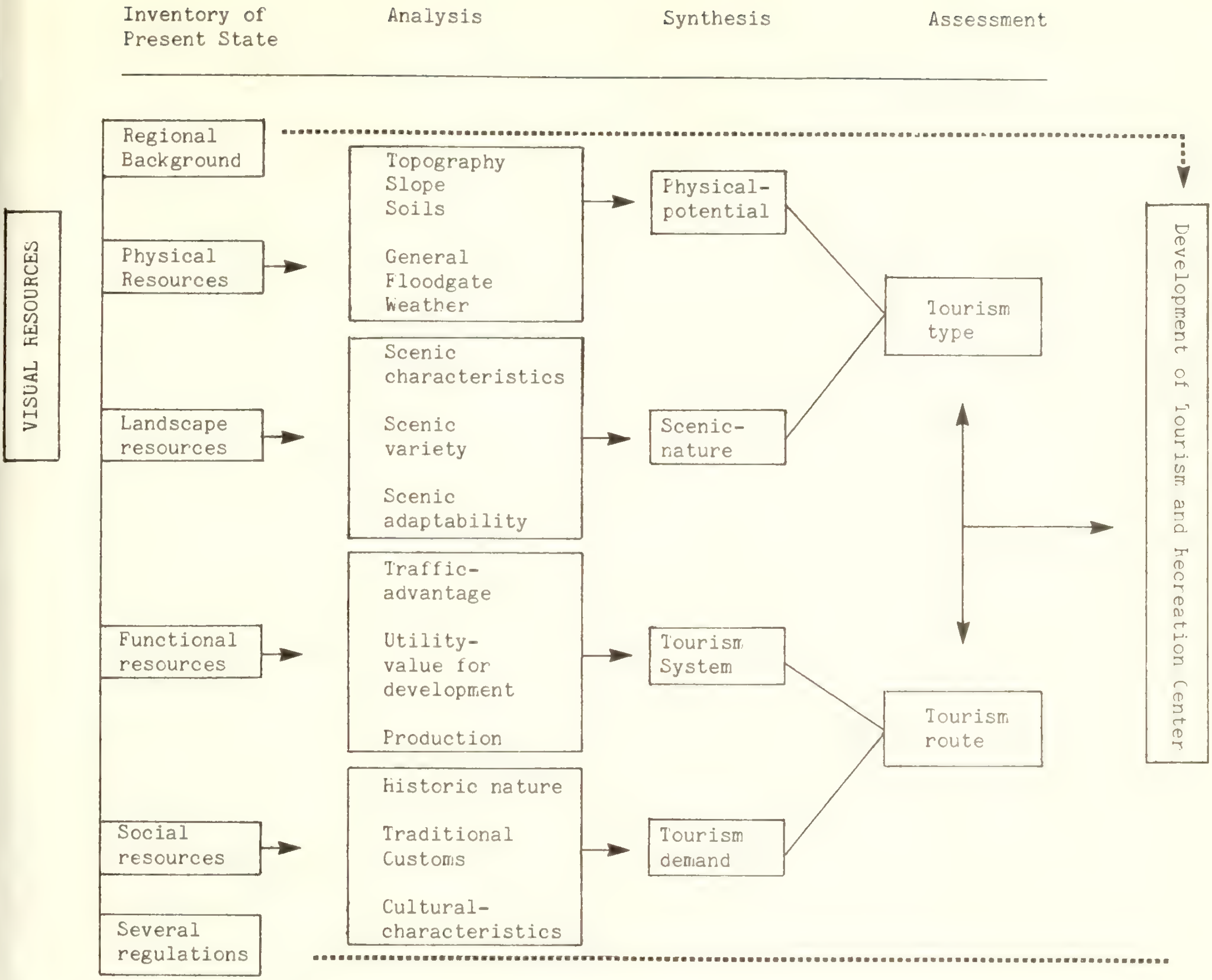

Figure 3--The process of the study

is called the Choon-Chon Lake district, and 4) the central district of So Yang Dam located 12 km northeast of Choon-Chon city.

METHOD OF STUDY

The method of this study was an attempt to document visual access by assigning foreground, middle ground and background (Litton 1968) along the land route. There is presently a paved two-track line. A single track railroad is under construction along the upper coast of the north river Han which is northeast of Seoul.

Process of the Study

Generally this process was advanced in proper sequence after inventory of the present state. It included analysis, synthesis and assessment. In particular, the analysis of the visual resources did not rely upon any quantitative measurement method. It included a subjective assessment of interest from mountains and water scenery based on a pure natural view of the Korean landscape (Youn 1974). The overall process is shown in Fig. 3.

Method of Approach

After the potential of the visual

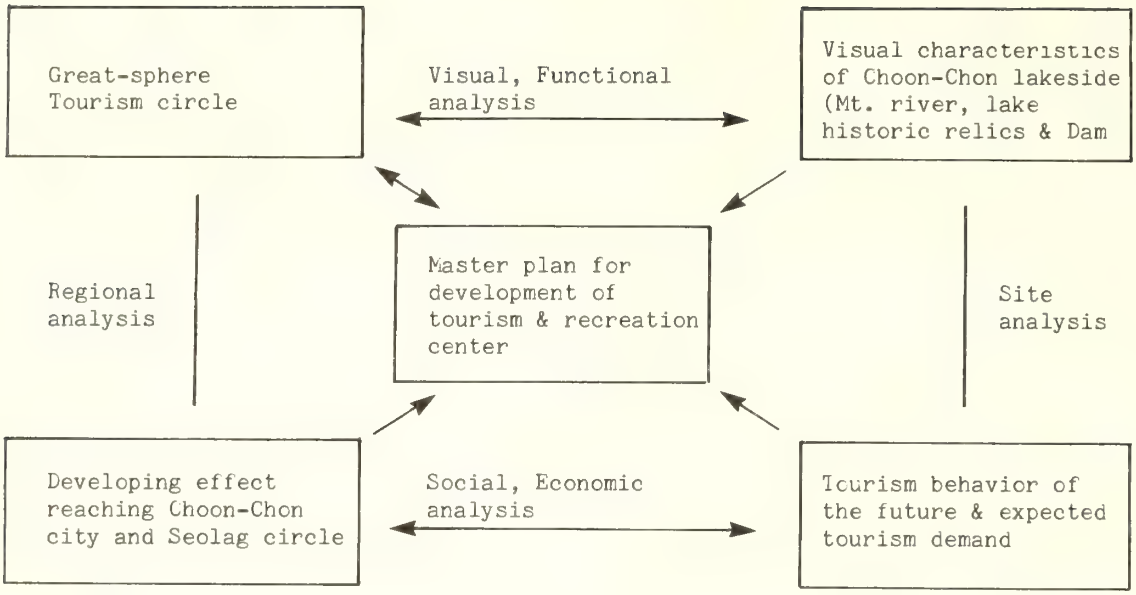
Great-sphere Tourism circle
Visual, Functional analysis
Visual characteristics of Choon-Chon lakeside (Mt. river, lake historic relics & Dam
Regional analysis
Master plan for development of tourism & recreation center
Site analysis
Developing effect reaching Choon-Chon city and Seolag circle
Social, Economic analysis
Tourism behavior of the future & expected tourism demand

Figure 4--Approach

resources and tourism center, which the Choon-Chon lakeside area involves, was inventoried, analyzed and assessed, it was projected as to the future potential tourism behavior and visual management. A diagramatic illustration for a desirable assessment of the visual resources of Choon-Chon area is shown by Fig. 4.

Comprehensive Map

The visual resources dispersed in this area, as based on the present state and analysis suggested above, were integrated via inventory maps. The analysis included detailed mapping of all the districts. While an intensive visual corridor along the north river Han is developing, the scenery itself is the dominant from. Lake Ui Am gives a special feeling of a distant and broad view of a mountain system and accompanying clouds. Chung Island and Tong Island lack vertical elements to give counterpoint to their vast horizontal space. Dung Sun Falls of the Samag Mountain district is a graceful scenic area, with interesting rock formations, and forms a visual vista. Choon-Chon Lake is at the far north end of the area. The calm lake among the mountains gives us peaceful and emotional sentiment and it is very good for fishing and boating.

Lake So Yang Dam is high with a steep slope and is the largest dam made of soil in the Orient. It utilizes a large valley to store a large amount of water. Its steep slopes and high mountains sink into the broad horizontal water surface. This area furnishes a variety of spatial experiences and directions. Lake So Yang is the largest artificial inland lake in the Orient. On the left valley of Lake So Yang, there can be found the old temple Chong Pyong temple, Am Bong, falls, forests, historic relics and other abundant tourism resources. In particular, natural monument-mandarin fish (fresh water fish) are found in rivers and lakes of the valley.

Assessment

The Visual Assessment is based upon three major concerns: 1) valuation for the use of tourism and recreation center, 2) resources for development and preservation in the future, and 3) perception of beautiful elements of the scenery (See fig. 5*) (Zube et al 1975). In particular, traditional-natural views in Korea tend to include mountains and water (Kim and Suh 1977) (see figure 6*),

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*See color illustration on page 392.

Ui Island

This island has an international meeting hall, lawn ground, picnic site, motel, pool, hotel, and boating).

Choon-Chon Lake Area

This area offers fishing, boating, and other waterside recreation activities.

So Yang Lake Area

This area has an international boat race, cable car, high class villa, yachting place, recreation center of Chong Pyong Temple valley, and water-transport for car-ferry to Yanggu and Inje reaching the entrance of Nae Sul Ak Mountain.

The above items are distributed in the drawing of synthetic planning.

CONCLUSION

The Choon-Chon lakeside area presently has rather poor transportation facilities to this mountainous, isolated area and limited access connection to other areas. It is also located near the DMZ northeast from Seoul. Economic development is low due to a small population and little development of industrial facilities. The area has not been recreationally developed because past tourism activity in Korea has focused on the southern parts. This area, which has been called a small diamond mountain of Korea, is located near the National Park of Sulag with abundant physical potential. If it is to play a larger role between the Seoul and Sulag tourism systems, four track lines between Seoul and Choon-Chon should be paved and expanded as an expressway in the near future. The existing railroad should become double-lined, and be extended to So Yang Dam. It should be connected to Nae (Inner) Sulag Mountain by water-transportation via car-ferry from So Yang Dam. I believe that this area has potential for developing appreciation and enjoyment of splendid landscape involving both active and passive water recreation activities and mountain scenery.

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Projecting the Visual Carrying Capacity of Recreation Areas[1]

Thomas J. Nieman and Jane L. Futrell[2]

Abstract: The aesthetic experience of people utilizing the recreational resources of the national parks and forests of the United States is of primary inportance since a large percentage of perception is visual. Undesirable intrusions into this sphere of perception substantially reduce the level of enjoyment or satisfaction derived from the recreation experience. Perceived visual disturbance levels of visitors to recreation areas were elicited on the following issues: 1) levels of perceived crowdedness, and 2) the presence of man-made elements in the use area, 3) the influence of man's actions on the landscape, and 4) the incidence of man-made elements in the viewing area. Disturbance level scores of hikers, picnickers and landscape architecture students indicate that visual disturbance levels increase as the incidence of disturbance elements increase. It is apparent that different users of recreation areas or use with a different intent will affect the visual carrying capacity of an area.

INTRODUCTION

Increasing demand for the utilization of recreational resources in the national parks and forests of the United States is a major concern of resource managers. Since the ORRRC reports (1962) overuse has reached such a level that recreation area use, Yellowstone National Park for example has been limited at peak times in the interest of ecology and the quality of the recreational experience of the users. Lovejoy (1973) states that: "The degree to which forests can absorb crowds without detriment is becoming an ever-more important factor in this overcrowded world. It must, however, be realized that forests have a saturation point, beyond which the health, as well as the enjoyability of the woo will decline." This saturation point is most often referred to as carrying capacity, and ha long been utilized to determine the resource potential of forest and range lands for purpos of management.

Recreation carrying capacity research has generally focused on physical site factors (Wager 1974) rather than on visual or percept conditions. The fundamental significance of t issue is that a large percentage of an individual's perception is visual. Since this involv the aesthetic experience in a particular resou based recreation area, the manner in which a visitor perceives a site will be an important factor in his level of enjoyment or satisfacti This study focuses on whether various levels of intrusion adversely affect a visitor's visual experience; and, if so, attempt to determine which elements appear to be most visually disturbing.

It is essential to recognize, however, tha carrying capacity is not a single absolute valu but a multi-dimensional concept. Although the term is frequently used, it is seldom understood. Stankey and Lime (1971) contend that no fixed figure can be singled out for a recreation area and be designated as the carrying capacity. Factors such as management objectives, physical resources, visual impact, type of user and volumes of use must all be considered in determining the optimum carrying capacity for a recreation area. In this study, carrying capacity is generally defined as "the amount of recreation use of a recreation resource which reflects the level of use most appropriate for both the protection of the resource and the satisfaction of the participant" (BOR 1977). Essentially, it is the level at which the visitor's experiential quality is maximized, while complying with the above restraints.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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Visual carrying capacity does not fit easily into the resource manager's perception of carrying capacity in that the effects are not easily quantified. Physical carrying capacity, which has been the focus of much research, deals with the actual physical determination of a site. Visual carrying capacity, however, embodies cultural values and relies heavily on how a visitor perceives a particular site for its determination. There is evidence to support the notion that increases in deterioration of recreational resources have caused many frustrations for visitors seeking an enjoyable experience (BOR 1977). In addition, there appears to be a paucity of information specifically correlating carrying capacity to visual quality.

Visual carrying capacity refers to conditions which an individual finds pleasing to the senses. On a particular site, it can be related to the perception of visual quality as it is affected by natural features, modifications of those features or deterioration of the environment (Bury 1976). Further, a visitor tends to express his satisfaction in terms of on-site perception, instead of expectations before the site is visited. For example, if a site is heavily used, it will inevitably produce signs of deterioration of the visual quality of the site. This, in turn, may adversely influence the quality of the visitor's experience particularly if he enjoys relatively undisturbed areas. Thus, the capacity of the site to instill a high quality of experience for its users will decline concurrently with the decline of the optimum carrying capacity level.

THE STUDY

A study to elicit perceived visual disturbance levels of visitors to recreation areas was designed which includes a consideration of the following issues: 1) levels of perceived crowdedness, 2) the presence of man-made elements in the immediate vicinity of the recreation experience, 3) the influence of man's action on the landscape and 4) the incidence of man-made elements in the viewing area.

1) Levels of perceived crowdedness is based on the hypothesis that individuals prefer less crowded areas for recreation enjoyment (Carls 1972). It is important to note that numbers of people alone do not cause crowdedness. Rather, crowding is essentially a subjective, individual perception of density. The context of the situation defines the appropriateness of the actual density (Stankey et al. 1976). However, "crowding does not detract from aesthetic enjoyment unless it destroys either the object viewed or the atmosphere in which it is viewed" (Willard 1971).

2) The presence of man-made elements in the immediate vicinity of the recreation experience is an issue which hypothesizes that individuals will prefer to use areas that are more natural than man influenced. Carls (1972), in a study of preferences for outdoor landscapes, found that "landscape scenes exhibiting a high magnitude of man-induced objects or conditions are less preferred than scenes with lower magnitudes--high levels of development detract from the aesthetic view of a landscape."

3) One issue is the influence of man's action in the landscape and this generates the hypothesis that people generally prefer to use trails or other recreation areas that are less physically disturbed or deteriorated. Bury (1976) contends that a relatively high level of use produces "signs of wear and tear on the natural beauty of a site," and that "this deterioration relates directly to the site's capacity to produce high quality experience for visitors who value natural, undisturbed areas."

4) Another issue is the incidence of man-made elements in the viewing area (from an overlook for example) which generates the hypothesis that man-made elements detract from the visitor's aesthetic enjoyment of that landscape. Zube et al. (1974) found that natural features "have a positive effect on scenic resource values" and that the intrusion of man-made elements leads to a great deal of variance among evaluators. Within recent years there has been general agreement that higher levels of development in a landscape setting leads to a reduction in preference (Carls 1972).

TESTING PROCEDURE

The above mentioned issues were represented by 12, 3-inch x 5-inch color photographs of recreation scenes in the Rock Bridge Recreation Area of the Daniel Boone National Forest, Kentucky, The photographs were selected according to three levels (high, moderate, low) of: 1) crowdedness, 2) presence of man-made elements in the use area, 3) man's actions in the landscape and 4) interference of man-made elements in the viewing area. All of the photographs represented outdoor recreation scenes or activities ranging from people using picnic areas...to hikers using trails...to views from an overlook area. To avoid seasonal bias, all photographs were taken in early September before leaves began to change color.

Color photographs were chosen as a means of assessment primarily for their availability and convenience to the on-site testing procedure. There are three basic advantages to using color photographs as a means of testing: the standardization of scenes (a ready frame of reference), no transportation of respondents (applicable only to landscape architecture student respondents) and as a measurement of landscape variables (Carls 1972). There is some question whether simulations, as a surrogate for on-site experiences, are an appropriate testing mechanism due to the relation of the other senses on the psychological perspective of the respondent toward these stimuli and the activity itself. However, Shafer and Richards (1971) and Zube et al. (1975) have demonstrated that color photographs are an efficacious means of eliciting evaluative responses. Kaplan and Wendt (1972) point out that "people like nature, that they even have a preference for graphics and photographic representations of nature ... understanding this preference may be an important step in the large and vital task of understanding the kinds of environments necessary for man's psychological well-being."

Three groups of respondents (N=177) were shown 12 photographs and asked to evaluate each in terms of the perceived visual disturbance felt when viewing the photo (1= not disturbed to 5= greatly disturbed). Two of the groups, 1) hikers (N=93) -- those visiting the park primarily to utilize the trails, and 2) picnickers (N=56) -- those visiting the park primarily to utilize the picnic facilities, were interviewed at the Rock Bridge Recreation area. The third group (N=28) consisting of junior and senior landscape architecture students at the University of Kentucky were interviewed during a class period.

Hikers, as a group, were selected on the premise that they hike individually or in small groups of 2 or 3 and would be less tolerant of disturbances that deviate from the natural landscape or of large numbers of people. Picnickers, the second group, were selected on the premise that they would be more people-oriented and more tolerant of man-induced influences on the natural landscape. Their activities would appear to indicate this in that picnic areas are generally utilized by fairly large numbers simultaneously and certainly suffer from more physical degradation than do hiking trails. The landscape architecture students were selected to determine whether individuals in an environmental design profession would be more tolerant or less tolerant of man-influence disturbances and large numbers of people than the other two groups--especially since the landscape architecture students have been trained to recognize and understand visual quality.

On two successive weekends in October, 1978, 149 people were interviewed in the Rock Bridge Recreation area. They were shown the series of 12 photographs, using six randomly ordered sets to minimize photo-order bias, and asked to rate each on the previously discussed level of felt-disturbance. Respondents were not requested to rank order the photos nor was there an attempt to get a comprehensive score across the entire photo grouping. The issue was to determine whether the respondents would express a feeling of disturbance relative to the depictions in the photographs.

RESULTS

Levels of Crowdedness

The hypothesis that individuals prefer less crowded areas for their recreational experiences and, as a result, will be more disturbed by photos which evidence a larger number of people in them was substantiated by the photo grouping in table 1. The level of disturbance increased distinctly from the A3 photo to the A1 photo and the levels of non-disturbance increased in the opposite direction. When viewing the sample in their respective groups (hikers, picnickers, landscape architecture students) some significant[3] differences appear. Hikers were very disturbed by a large number of people in the scene but were not greatly disturbed by the medium and low levels. Also, they were generally more disturbed by all levels of crowdedness than either the picnickers or the landscape architecture students. The picnickers, on the other hand, were generally less disturbed by all levels of crowdedness. This is especially true with respect to the A1 photo where many were not disturbed by the highest level of crowdedness shown. The landscape architecture students were neither greatly disturbed nor undisturbed by the number of people in the photos. Rather, they were mildly disturbed by all the photo situations.

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[3] A chi-square statistic was utilized to test for differences. A probability level of .10 or greater was accepted as significant.

Table 1--Level of crowdedness

	Photo A1* High(a)			Photo A2* Moderate(b)			Photo A3* Low(c)		
	Very	Mildly	None	Very	Mildly	None	Very	Mildly	None
Hikers N=93	40	38	23	14	41	45	4	24	72
Picnickers N=56	23	36	41	20	38	43	0	27	73
Landscape Arch. Students N=28	21	43	36	11	68	21	0	50	50
Total N=177	32	38	31	15	44	41	2	29	69

* Figures represent percentage of disturbance
(a) X^2 = 8.596 with 4°F, significant at 0.072
(b) X^2 = 8.62 with 4°F, significant at 0.0713
(c) Statistics not valid because of "0" cells

The issue of carrying capacity, relative to the perception of crowdedness in the photos, reveals that individuals are not disturbed by low numbers of people in outdoor recreational areas. As numbers increase the level of disturbance increases to where disturbance (mild or high) is expressed by a majority of the respondents. Individuals are disturbed by what they perceive as crowded conditions in outdoor recreation areas. This negatively affects their enjoyment level and, thus, the perceptual or visual carrying capacity of the recreation area is decreased or surpassed.

While the reaction of the on-site users was anticipated, it is interesting to note the landscape architecture students' generally mild concern for crowded conditions and their perception of people as being an undisturbing factor in the pursuit of visual quality. This can possibly be explained by their training as designers of spaces for human use and enjoyment. In this respect they would be gratified to view a recreation area that is neither over crowded nor under utilized. People using the facility would not be a cause for great disturbance. There may be concern that too large a crowd would detract from the visual amenities of the area and thus the recreational enjoyment.

Presence of Man-Made Elements

In this series of photos (table 2) it was hypothesized that the disturbance level of individuals will increase as the presence of man-made elements increases in the outdoor recreation landscape; an issue which was corroborated by the photo test across the entire sample. As the incidence of man-made elements in the landscape increased the percentage of very disturbed responses increased and vice versa for the non-disturbed responses. Among the groups, the landscape architecture students appear to be the most sensitive to the presence of man-made elements in the outdoor recreational scene. Many were very disturbed by the B1 photo with just a few expressing a feeling of non-disturbance. In comparison, hikers expressed disturbance at the higher level presence of man-made elements but were not particularly concerned over the low level. As in the crowdedness photos the picnickers were somewhat less disturbed by the presence of man-made elements in the recreation area than their fellow recreation users, the hikers.

The landscape architecture students' extremely sensitive concern for the presence of man-made elements in the scene may be attributed to several factors. Unlike the hikers and picnickers they were not utilizing the picnic facilities or the hiking trails at the time of the testing but were interviewed in a design class situation. Another issue is that they, as designers, may have been disturbed by what one individual called "the clutter" of the scenes. In other words, their perception of well designed recreation areas may not have concurred with what they saw in the photographs, thus they were critical. The indication of less disturbance on the part of the picnickers may be rationalized on the basis that they were actually in the process of using similar facilities.

They were relating more closely to the scenes and were not as disturbed as the hikers who were just passing through to utilize the adjoining trail system. This is consistent with Brush's (1976) findings that "non-experts" (the general public) have a tendency to be more tolerant of "man-made influences, particularly those that are familiar to them, or that contribute to their own comfort and convenience" and that "the ratings of observers are influenced to some extent by their ... prior experience."

Table 2--Presence of man-made elements in the use area

	Photo B1* High(a)			Photo B2* Moderate(b)			Photo B3* Low(c)		
	Very	Mildly	None	Very	Mildly	None	Very	Mildly	None
Hikers N=93	27	45	28	16	25	59	2	16	82
Picnickers N=56	23	41	35	13	35	51	4	18	79
Landscape Arch. Students N=28	71	29	0	14	57	29	4	36	61
Total N=177	33	41	26	15	33	52	3	20	77

*Figures represent percentage of disturbance
(a) Statistics not valid because of "0" cell
(b) X^2 = 11.108 with 4°F, significant at 0.025
(c) Significant levels less than allowable .10

In respect to the presence of man-made elements having an affect on the visual carrying capacity of a recreation area, the issue does not appear as strong as the crowdedness issue. It was not until the high level of man-made elements photo that a majority indicated some level of disturbance. Evidently some man-made elements in the recreation area are entirely acceptable for all groups--are even expected, e.g., toilets, water, tables, etc. When they reach such a level that the elements begin to appear everywhere, problems develop and visual perceptions are distinctly offended.

Presence of Man's Influence

The third photo grouping results, that of the presence of man's influence on the outdoor recreation scene (table 3), concurred with the hypothesis that the level of disturbance would increase as the presence of influence increased Relative to the previous photo groupings it is interesting to note that the overall level of disturbance was not very great, even for the photo with a high level of man's influence present. Statistically, except for the landscape architecture students in photo C1, there was little group differentiation. The landscap architecture students, as in the case in the previous photo set, were considerably more disturbed by the high level of man's influence than were the on-site users.

The hikers, who in the two previous photo groupings were disturbed by people and man-made elements, were relatively non-disturbed in this case. However, since the hikers came to the recreation area to utilize the trails and the photos depicting degradation of the recreation scene were of such trails, it was not very like that they would express great disturbance by their condition, no matter how worn or eroded. Wohwill (1976) suggests that familiarity acts to decrease disturbance and that individuals tend to prefer landscapes that are similar to ones which they are most closely affiliated. Thus, familiarity with a specific environment tends to obscure the dissonance of its general arrangement (Nieman 1978).

The landscape architecture students' sensitiveness throughout is not as easily explained on the basis of the data collected and further testing would be required. It must, however, be emphasized that they were not actively engaged in an outdoor recreation pursuit at the time. Without a vested interest to relate to in the sense of enjoyment, they were apparently at liberty to be more discriminating and thus to indicate a higher level of disturbance. The fact that the trails were eroded and obviously overused could also have affected their environmental design sensitivities and influenced them to react negatively to environmental degradation whatever the situation.

The visual carrying capacity issue in this situation is not so clear cut. Even at the highest level of man's influence only 39 percent of the sample expressed any feeling of disturbance. In this case photos of blatent destruction, such as vandalism, were not utilized in an attempt to screen other perceptions from unduly influencing the judgment. Apparently on-site recreation users are willing to accept a certain degree of site degradation if it has resulted from normal every day use. While park managers may be concerned over site degradation it does not follow that the public will perceive such degradation as unacceptable or undesirable (Hendee and Harris 1970). In addition, Lucas (1970), found that Forest Service Administrators ranked the quality of recreational sites much differently than did the users. They consistently ranked the sites higher and more desirable than the managers, who had ranked the sites only as fair. Consequently, on-site users' expression of a significantly lower level of visual disturbance than the landscape architecture students' is consistent with other findings.

Table 3--Presence of man's influence

	Photo D1* High(a)			Photo D2* Moderate(b)			Photo D3* Low(c)		
	Very	Mildly	None	Very	Mildly	None	Very	Mildly	None
Hikers N=93	3	29	68	2	7	91	0	4	96
Picnickers N=56	5	29	66	2	14	84	0	4	96
Landscape Arch. Students N=28	25	46	29	7	25	68	4	14	82
Total N=177	7	32	61	5	12	85	1	6	94

*Figures represent percentage of disturbance
(a) $X^2 = 22.389$ with 4°F, significant at 0.002
(b) Significance levels less than allowable .10
(c) Statistics not valid because of "0" cell

This difference suggests that professionals may not be totally perceptive to the actual feelings of the recreational user. It is also evident that issues beyond the actual physical conditions of the site or the numbers of people using it influence the decision to be less critical of a site's amenities than those reacting in a more objective sense, i.e., managers and designers.

Views with the Presence of Man-Made Elements

The results of testing in the fourth category of man-made elements in the view (table 4), concurred with the hypothesis of increasing disturbance as the level of disturbance-elements increases, but only marginally. Very little disturbance was registered by the sample as they viewed the photos. In both the high and the moderate photos, the majority did not see the presence of man-made elements as disturbing. Further, there was little disturbance difference among the three groups. All generally agreed that the presence of these particular man-made elements in the view was not particularly disturbing. As related to visual carrying capacity, two issues can be addressed that may help to explain the lack of expressed disturbance. Grossly obtrusive objects like power lines or stacks belching smoke were not utilized in the photos, rather they were relatively orderly. Rabinowitz and Coughlin (1970) found that people prefer man's influence in the natural landscape as long as it is orderly and does not contain evidence of visual pollution. Secondly, this was the only series of photos which included water in the scene. Brush and Shafer (1975) contend that moderate proportions of water tend to add to an individual's perception of visual quality in the landscape and Kaplan (1977) found that water provides a unifying and continuing theme to the landscape. It appears that the context of man-made elements in the landscape may be an important factor in that if they are perceived as orderly and possibly even belonging, they do not detract from the visual enjoyment of the scene.

Table 4--Views with man-made elements

	Photo D1* High+			Photo D2* Moderate+			Photo D3* Low+		
	Very	Mildly	None	Very	Mildly	None	Very	Mildly	None
Hikers N=93	13	24	63	9	24	68	0	7	94
Picnickers N=56	7	23	70	7	21	71	0	5	95
Landscape Arch. Students N=28	0	36	64	7	43	50	0	7	93
Total N=177	9	25	66	8	26	66	0	6	94

*Figures represent percentage of disturbance
+No statistically significant differences among the groupings.

CONCLUSION

The results of the study indicate that disturbance levels increase as the incidence of disturbance elements increases. While the trend in this direction is consistent across the entire sample, individual groups varied in the magnitude of felt disturbance, Crowdedness as a visual carrying capacity element was a clear indicator of disturbance, as was the presence of man's influence and views with man-made elements in the scene in that the respondents were not greatly disturbed by their appearance, It is important to reiterate that the scenes were relatively ordinary. They did not include spectacularly beautiful views or exceptionally undesirable situations. Since the majority of recreational experiences, especially in the Kentucky region, are undertaken in ordinary situations it was thought appropriate not to confuse the respondents with extraordinary situations.

Group variance also evolved which verifies the issue of use intent or situation. Hikers are most disturbed by high levels of crowdedness, followed by the presence of man-made elements, views with man-made elements and the presence of man's influence. This concurs with the general intent of hiking, that of using a developed trail system to escape people and their elements and to enjoy the scenic quality of the area. Had the presence of man's influence-elements been other than eroded trails perhaps the disturbance level of hikers would have been higher. This, however, reinforces the issue of intent. The intent was to use the trails, therefore, some degradation of the trail system was not all that disturbing.

Picnickers were also disturbed by high levels of crowdedness and the presence of man-made elements but not to the extent of the hikers. Throughout the evaluation they were more tolerant of disturbance elements. Once again this is consistent with their intent and expectations. They came to the area intending to utilize the recreation facilities and they expected to see recreational situations similar to the ones in the photos. The concept of familiarity appears to be a dominating influence in that these are situations normally experienced by picnickers.

Landscape architecture students, the only group not interviewed while participating in an outdoor recreation experience, were greatly disturbed by the presence of man-made elements in the recreation landscape. Their next highest concern was for the presence of man's influence which is in contrast to the other groups who expressed little concern for trail degradation. Levels of crowdedness were next, followed by views with man-made elements.

The issue of visual disturbances affectin an individual's perception of the visual carry capacity of an area leaves little doubt that pe are disturbed, On-site users, however, tend t be less disturbed and are certainly less criti of interferences in the natural scene, On the other hand, landscape architecture students appear to be more sensitive to visual interferences, Their intent, of course, is different than that of the on-site users. It is likely that their criticism is more technical, as a result of their training, than their feelings as potential site users. This introduces the issue of environmental designers planning recreation areas not knowing what users prefer or what they will accept. Another possibility exists that designers are viewing the scenes with more environmental knowledge and therefor forsee a time, somewhere in the future, when the recreational area will be unsuitable for use from both an ecological and aesthetic perspective.

Clearly, different groups of users or use of recreation areas with different intents affect the visual carrying capacity of an area While other carrying capacity issues, in the physical sense, continue to be important considerations, knowledge of when the visual sensitivities of recreation users are offended and in what respects will aid greatly in the control and use of existing park facilities and the design of new facilities. Knowing, a priori, where this point is likely to be will benefit park planners and ultimately influence the success of recreational experiences.

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Visual Resource Inventory and Imnaha Valley Study: Hells Canyon National Recreation Area[1]

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and Frank Hunsaker[3/]

Abstract: Hells Canyon National Recreation Area was established by an Act of Congress in December 1975. At that time, the U.S. Forest Service, which administers most of the land included, was given the responsibility of developing a Comprehensive Management Plan for the NRA within five years. In order to minimize future visual degradation, the Forest Service planning team for the NRA decided that the USFS Visual Management System should be applied to the entire area. The purpose of this system is to define Visual Quality Objectives for the land examined and also to determine the relative difficulty of meeting these objectives.

In September 1977 the consultant was selected to implement the Visual Management System for the 662,000-acre NRA and also to conduct a detailed river corridor analysis of the 70-mile long Imnaha River Valley in order to determine land development guidelines. The Imnaha River Valley is an integral part of the NRA, but is not typical in that it contains significant amounts of private land used for ranches and residences.

INTRODUCTION

Hells Canyon National Recreation Area was established by an Act of Congress in December 1975. At that time, the U.S. Forest Service, which administers most of the land included, was given the responsibility of developing a Comprehensive Management Plan for the NRA within five years.

Many of the management activities that ar necessary for the establishment and operation the NRA may disturb the natural landscape valu that are its basic resource. These activities may include timber harvesting and grazing as well as the construction of roads, trails, cam grounds, overlooks, visitor centers, etc. In order to minimize future visual intrusion, the Forest Service Planning Team for the NRA decided that the USFS Visual Management System is to define Visual Quality Objectives (based on inherent scenic quality and viewer sensitiv to this), for the land examined and also to determine the relative difficulty of meeting these objectives.

Hells Canyon NRA is located on either side of the Snake River in the northeast corner of Oregon and west central Idaho. It includes 662,000 acres (over 1,000 square miles) and is of irregular shape, measuring 75 miles north-south and 35 miles east-west. Figure 1 shows

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its location relative to the States of Oregon, Idaho and Washington.

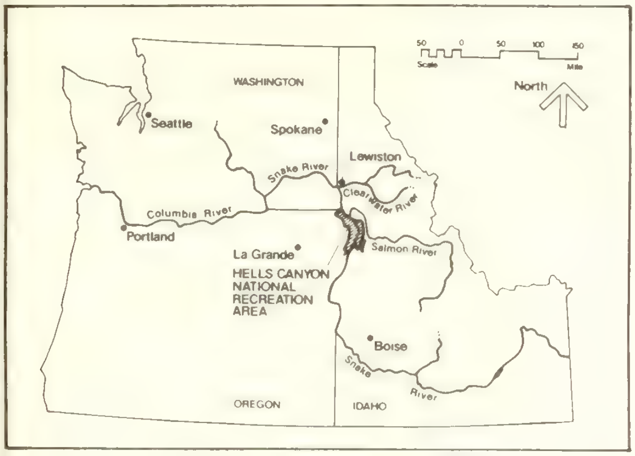

Figure 1. Location Map

The NRA consists principally of land from three National Forests; the Wallowa-Whitman, in Oregon and the Nezperce and Payette in Idaho, each Forest being part of a different Forest Service Region. Within the NRA there are two designated wilderness areas and three wilderness study areas. The Snake, as it flows through the NRA, is a designated Federal Wild and Scenic River. The Rapid River on the eastern edge of the NRA is a Wild River.

The topography of the area is extremely varied and includes the steep, rugged 5000-foot deep canyon of the Snake River (Hells Canyon), the Alpine terrain of the Seven-Devils Mountains (rising to 9000 feet), the high plateau land west of the Snake and many narrow scenic valleys including those of the Imnaha and Rapid Rivers.

VISUAL MANAGEMENT SYSTEM[1]

The Visual Management System consists of five basic steps and is applied to the entire National Recreation Area, including the Imnaha Valley. The five steps are outlined below and illustrated on Figure 2: Overall Methodology Diagram. The Imnaha Valley Study is a sixth step in the process.

STEP 1. LANDSCAPE VARIETY CLASS

Three classes of landscape variety (which is equated with scenic quality) are defined. Geographic units (landscape character types), are described and used as a frame of reference to judge variety. Using aerial and site photography and topographic maps, landscape variety classes are delineated.

STEP 2. SENSITIVITY LEVEL

Three sensitivity levels (measures of people's concern for scenic quality) are defined. The use features of the NRA are classified as of primary or secondary importance. The types of user of each feature are identified and assumptions made as to their degree of concern for scenic quality. Feature importance and user concern are combined and sensitivity level of use features delineated. Viewpoints at these use features are chosen and the areas seen from them delineated, taking distance from the viewer into consideration.

STEP 3. VISUAL QUALITY OBJECTIVES

The previous two sets of values are combined and each resulting combination delineated and given a Visual Quality Objective; one of four ranging from "Retention" to "Maximum Modification." Designated wilderness areas receive a special VQO of "Preservation."

STEP 4. VISUAL ABSORPTION CAPABILITY

In this step the relative ability of the land to absorb visual change is assessed as a measure of the difficulty of achieving the previously defined VQO. The VAC of four environmental factors is analyzed. These are: slope, vegetation type, soil type and soil/vegetation color contrast. The various conditions found within each factor are assessed and classified into high, medium or low Visual Absorption Capability. These are delineated separately and then combined to show composite VAC values.

STEP 5. VQO & VAC: COMPOSITE VALUES (VISUAL MANAGEMENT CLASSES)

The VQO values (the product of Step 3, and the Composite VAC values (from Step 4) are here combined and delineated. These final composite values are supplementary to the VQO and VAC values. All three will be used as tools in the development of a management plan for the NRA.

STEP 6. IMNAHA VALLEY STUDY

The three sets of values (VQO, VAC and Composite VQO/VAC) derived in the above steps apply to the entire NRA including the Imnaha Valley. In the Valley, however, because it is relatively highly developed, two additional

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[4] As developed by the U.S. Forest Service prior to the Hells Canyon Study.

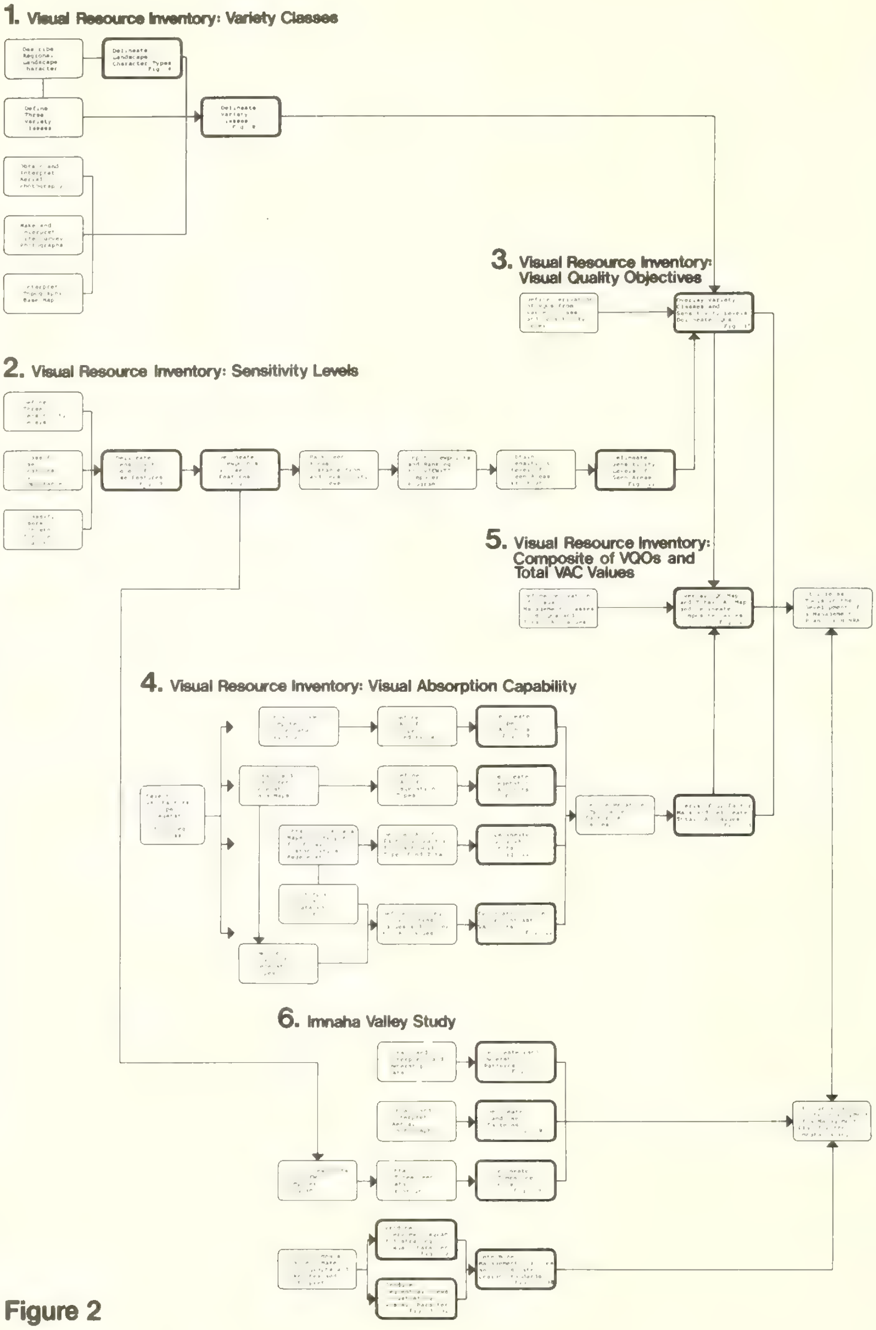

1. Visual Resource Inventory: Variety Classes
Describe Regional Landscape Character
Delineate Landscape Character Types
Define Three Variety Classes
Delineate Variety Classes
Obtain and Interpret Aerial Photography
Make and Interpret Site Survey Photographs
Interpret Topographic Base Map
2. Visual Resource Inventory: Sensitivity Levels
3. Visual Resource Inventory: Visual Quality Objectives
Overlay Variety Classes and Sensitivity Levels
5. Visual Resource Inventory: Composite of VQOs and Total VAC Values
4. Visual Resource Inventory: Visual Absorption Capability
6. Imnaha Valley Study

Figure 2

OVERALL METHODOLOGY

Hells Canyon National Recreation Area
Visual Resouce Inventory and Imnaha Valley Study

U.S. Department of Agriculture, Forest Service
EDAW inc.

factors are examined and delineated. These are land ownership and land use. Moreover, because the Valley will be experienced in a linear fashion by users of the NRA, and because specific developments may affect scenic quality, the frequency of visibility from the valley road is assessed and delineated.

The visual character of the Valley is illustrated in a series of sequential views and a summary plan diagram. Finally, suggestions and recommendations for planning and design standards that might be applied to new and existing development are presented in graphic form.

VARIETY CLASS

The inherent scenic quality or value of the land making up the NRA is, for planning purposes, equated with landscape variety or diversity. Three variety classes are defined, into one of which any area of land can be fitted. The classes are:

- o Class A - Distinctive
- o Class B - Common
- o Class C - Minimal

Landscape character types are used as a frame of reference to classify the physical features of a given area as to their degree of variety.

Class A - Distinctive, refers to those areas where landforms, rockforms, vegetative patterns or water features are of unusual or outstanding visual quality within the character type. They are therefore usually not common in the character type (but may be common in a sub-type). Class B - Common, refers to those areas where features do contain variety in form, line, color and/or texture, but to a degree that tends to be common throughout the character type. The features are not outstanding in visual quality. Class C - Minimal, refers to those areas whose features have little change in form, line, color and/or texture. Class C includes all areas that do not fit into Classes A or B.

The landscape character types are based on physiographic sections as defined by Fenneman in "Physiography of the Western United States."

From the character type, variety classes of the landscape were determined and mapped (see Map 1).

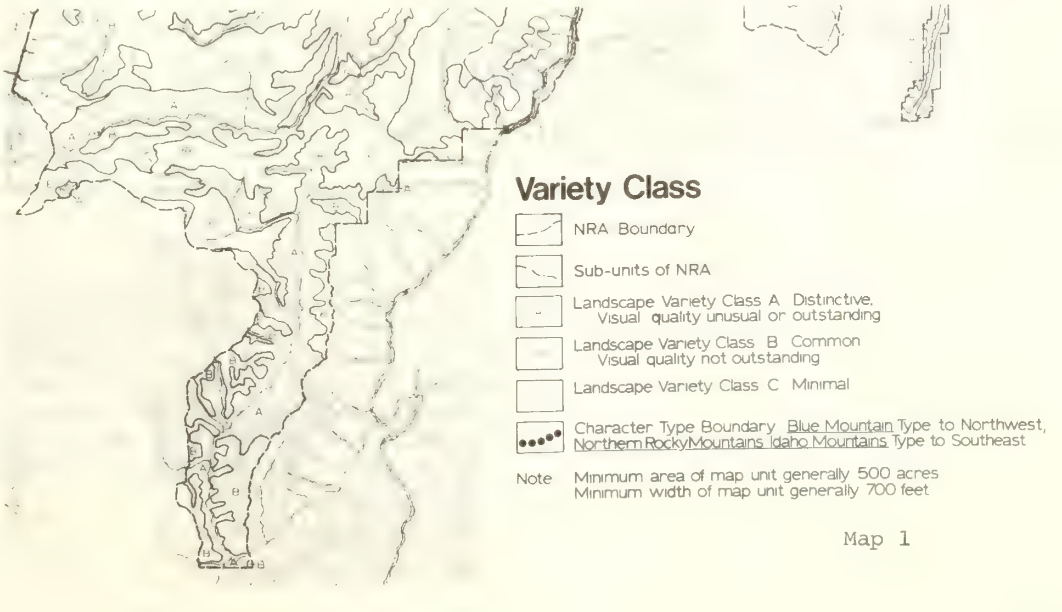
SENSITIVITY LEVEL

Sensitivity levels are a measure of people's concern for scenic quality. The sensitivity measured is not that of a viewed landscape to a given disturbance. Rather it is the mental state or level of expectation of scenic quality of the users of the NRA, whether recreationists, local inhabitants, ranchers, forest products workers or Forest Service personnel.

Three sensitivity levels are used, each identifying a different level of user concern for the visual environment. These are:

- o Level 1 - Highest Sensitivity
- o Level 2 - Average Sensitivity
- o Level 3 - Lowest Sensitivity

Measurement of visitor sensitivity to the visual environment is necessarily somewhat subjective. A two-step process is used here. First, the travel routes, use areas and water bodies (the principal locations of the users of the NRA), are identified as being of either primary or secondary importance within the NRA. Secondly, the types of users of each use feature are identified and assumptions made as to their concern for visual quality. The importance and the users concern are then correlated and final sensitivity levels determined.


A
A
A
A
A
B
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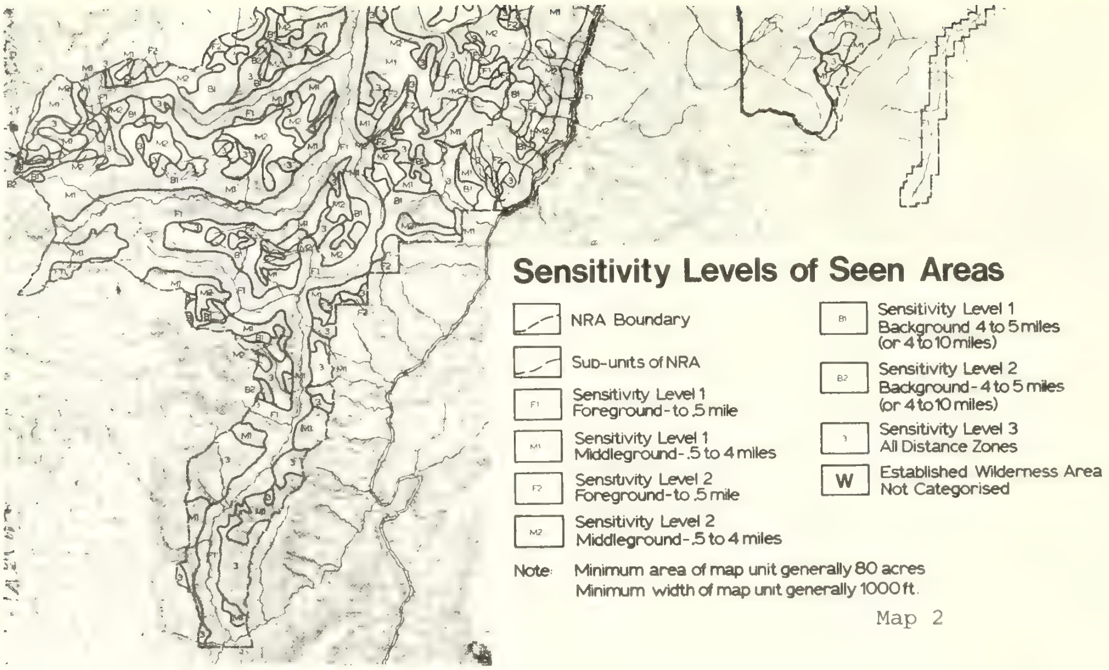
Variety Class
NRA Boundary
Sub-units of NRA
Landscape Variety Class A Distinctive. Visual quality unusual or outstanding
Landscape Variety Class B Common Visual quality not outstanding
Landscape Variety Class C Minimal
Character Type Boundary Blue Mountain Type to Northwest, Northern Rocky Mountains Idaho Mountains Type to Southeast
Note Minimum area of map unit generally 500 acres Minimum width of map unit generally 700 feet

Map 1


Sensitivity Levels of Seen Areas
NRA Boundary
Sub-units of NRA
F1 Sensitivity Level 1 Foreground - to .5 mile
M1 Sensitivity Level 1 Middleground - .5 to 4 miles
F2 Sensitivity Level 2 Foreground - to .5 mile
M2 Sensitivity Level 2 Middleground - .5 to 4 miles
B1 Sensitivity Level 1 Background 4 to 5 miles (or 4 to 10 miles)
B2 Sensitivity Level 2 Background - 4 to 5 miles (or 4 to 10 miles)
3 Sensitivity Level 3 All Distance Zones
W Established Wilderness Area Not Categorised
Note: Minimum area of map unit generally 80 acres
Minimum width of map unit generally 1000 ft.
F1
F2
M1
M2
B1
B2
3

Map 2

The VIEWIT computer program was used to assist in determining the sensitivity levels. This process uses predetermined viewpoints, whose coordinates are fed into the computer along with the radius of view the computer is to scan. Seven hundred eighty (780) viewpoints were used to cover 1000 square miles.

The sensitivity level computer printout was then manually transferred to the base map as is shown in Map 2 above.

VISUAL QUALITY OBJECTIVES

In the previous two steps of the process, the inherent scenic quality (variety class) and the public's concern for scenic quality (sensitivity level) were defined for all lands within the NRA.

This third step combines these two values and thus determines various degrees of acceptable alteration of the natural-appearing landscape. That is, visual quality objectives (VQO's), can now be defined for all areas of the NRA, including areas where cultural patterns are conspicuous, since the types of cultural features that exist in the NRA are generally seen as part of the characteristic landscape and should be treated as such. These objectives dictate the type, scale and extent of management activities that may be performed.

Five Visual Quality Objectives are used. These are:

o	Preservation	P
o	Retention	R
o	Partial Retention	PR
o	Modification	M
o	Maximum Modification	MM

These objectives are derived from, and keyed to, the variety classes and sensitivity levels previously defined. Each describes a different degree of acceptable alteration of the natural landscape. The degree of alteration is measured in terms of visual contrast with the surrounding landscape that is generated by introduced changes in form, line, color or texture.

The VQO's for the National Recreation Are are set as if the landscape was entirely natur and contained no management-caused visual impa In fact, there are areas where existing visual trusions (roads, clear cut areas, transmissior lines, etc.) may not meet the VQO's that this study defines. In these cases, a short-term v ual resource management goal -- rehabilitatior may be applied. Once the short-term goal is attained, the original VQO then applies to all subsequent management activities. The definit of areas that require rehabilitation was beyor the scope of this study (see Map 3).*

VISUAL ABSORPTION CAPABILITY (VAC)

Visual Absorption Capability (VAC) is a measure of the relative ability of the land to absorb visual change. VAC assessment is desig to indicate the best locations for a proposed management activity within a given VQO area.

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*See color illustration on page 393.

There are numerous factors that influence Visual Absorption Capability. These can be divided into perceptual factors and physical factors. Perceptual factors include: distance, number of times seen, number of viewers, duration of view, focal point sensitivity, slope relative to observer, etc. Most of these factors require exact and minute knowledge of the land to be assessed (obtainable only by site examination) and/or much detailed knowledge of the viewers.

Thus, they are suitable for project level assessments where viewers are located in a limited area, perhaps along one road, but are impracticable for large-scale land use planning projects such as this one, where the area is too large for all portions to be seen in the field and where the exact type, number and location of the viewers are not always known.

Physical factors are variable aspects of the land, such as slope, that change the inherent visibility of a given management action as they vary. For example, slope varies from flat to steep. Other physical factors being equal, a given management activity such as construction of a road, will be inherently more visible when performed on an area of steep slope than on flat land.

Four physical VAC factors have been selected for examination on the NRA. These are:

- o Slope
- o Vegetation type
- o Soil type
- o Soil/vegetation color contrast

A number of Forest Service VAC studies were examined and the VAC factors that had been used on large-scale land use planning studies were listed. The above four factors were selected (using the list as a starting point) because, in the course of extensive site visits, each had been observed to be significant and to vary widely in the NRA. In addition, reasonably complete data were thought to be available for these factors. Each factor was divided into three classes of visual absorption capability; high, moderate and low. The conditions classed high are those with the most capacity to absorb visual change; the easiest, lowest cost areas in which to perform management activity from the visual resource point of view. Conversely, low VAC areas are those which do not absorb much visual change. It is more difficult and costly in these areas to carry on management activities and still attain the visual quality objectives defined.

Before the total, or composite, VAC values of all of the parts of the NRA can be assessed, the relative weight of each of the four subsections must be determined. This must necessarily be done by subjective judgment. Based on the past experience of the Forest Service, and on an understanding of the relative importance of the four factors derived from site examination, relative VAC values were determined and are shown on Figure 3.

FACTOR	CHARACTERISTICS	VAC VALUES	
		VERBAL	NUMERICAL
Slope	Steep (55%+ slope)	low	1(multiplier)
	Moderately steep (25%-55% slope)	mod.	2(multiplier)
	Relatively flat(0-25% slope)	high	3(multiplier)
Vegetation	Barren, grass/brush	low	1
	Conifer, hardwood, cultivated altered	mod.	2
	Diversified (mixed open and woodland)	high	3
Soil	High constraint value derived from high erosion hazard and/or high instability hazard and/or poor regeneration potential	low	1
	Moderate constraint value derived from erosion hazard and/or instability hazard and/or regeneration potential	mod.	2
	Low constraint value derived from low erosion hazard and/or low instability hazard and/or good regeneration potential	high	3
Soil/ Vegetation Contrast	High visual contrast between exposed soil and adjacent vegetation	low	1
	Moderate visual contrast between exposed soil and adjacent vegetation (and all barren, cultivated and diversified vegetation types)	mod.	2
	Low visual contrast between exposed soil and adjacent vegetation	high	3

Figure 3. Relative Importance of VAC Factors.

In summary, Vegetation, Soils and Soil/Vegetation color contrast are all weighted equally and in an arithmetically increasing scale. The lowest slope VAC value has no effect on the sum of the other three, a moderate slope VAC doubles the sum and a high slope VAC triples the total of the remaining factor values. Thus, the final Visual Absorption Capability Values are derived from the formula:

Total VAC = Slope VAC x (Veg. VAC + Soil VAC + Contrast VAC)

The formula for calculation of total VAC -- Slope X (Veg. + Soil + Contrast) was applied, giving a single numerical value for each map unit. The lowest possible score is 1 x (1 + 1 + 1) = 3. The highest possible score is 3 x (3 + 3 + 3) = 27. The frequency of occurrence of the various total VAC scores was estimated by sampling a number of randomly selected areas of the NRA and dividing the range so that the number of low, moderate and high scores was, as nearly as possible, equal. This grouped the numerical scores into the three categories: low, moderate and high. The final total or Composite VAC Map was then produced (see Map 4). *

COMPOSITE VQO/VAC VALUES

Once the VQO and the VAC of an area had been mapped, a composite map was made showing relative ease or difficulty of accomplishing various management activities. This composite can be used to influence the location of specific projects required in the new NRA, as well as the methods used to design, construct and maintain these projects.

The composite VQO/VAC map units, or visual Management Classes, were obtained by overlaying these two maps and defining new units.

The units are defined, not on the basis of the simple VQO's themselves, but of the various combinations of Variety Class and Sensitivity Level that determined the VQO's. For example, a Sensitivity Level I Middleground on the Variety Class A land both have the Partial Retention (PR) Visual Quality Objective. Composite VQO/VAC units are defined on the basis of each of the above two VQO units, not just for the overall PR VQO condition. This makes it easier for the land manager to refer back to the VQO map to find the specific combination of variety class and sensitivity level of seen area that determined the VQO.

Map 5 is the combination of the Visual Quality Objective Map and the Visual Absorption Capability Map.

IMNAHA VALLEY STUDY

The Imnaha Valley lies within the NRA, but differs from it in several important ways. Whereas the bulk of the NRA is publicly-owned and undeveloped, the Imnaha has significant amounts of private land within it, often developed as irrigated pasture or cropland and has many homes and ranches.

The Act establishing Hells Canyon NRA (December 1975) states that ranching, grazing, farming, timber harvesting and the occupation of homes and lands associated with these activities (as they existed at the time of enactment of the Act) are recognized as traditional and valid uses of the National Recreation Area. The Act also states that standards for the use and development of privately-owned property within the NRA shall apply. It is one of the main purposes of this Imnaha Valley study to provid suggestions and recommendations from the point of view of visual quality, that will enable th NRA planning team, with the involvement of the private landowners affected, to develop such standards. This study is also intended to assist the NRA planners to locate management activities on the publicly-owned lands within the Imnaha Valley and to ascertain the probability of any proposed private development having an adverse visual effect.

The Valley study consists of three parts:

(1) Three pairs of data maps that supplement the NRA-wide visual resource inventory maps and give a more detailed picture of the Imnaha Valley. The data maps are:

- Land Ownership (North and South halves)
- Land Use (North and South halves)
- Visibility: Times-Seen (North an South halves)

(2) Sequential views at about one mile intervals of progressions through th Valley north to south and south to north with a description and an over all map-diagram illustrating the relationship of the viewer, moving alo the main Valley road to the major topographic and cultural features of the Valley.

(3) Suggestions and Recommendations for planning and other design standards that might be applied to new and existing development in the Valley. These consist of:

- Illustrations and discussions of some existing agricultural operations and residential development that fit well into the NRA.
- Illustrations of situations in or near the Imnaha Valley portion of the NRA that detract from the vis quality of the area with graphic illustrations and descriptions of possible improvements.
- Illustrations of some different levels of residential development in the Imnaha Valley with di cussion of the effect of these on the visual character of the Valle

Figure 4 on the following page is one of six series of sketches that represent the visual experience as one progresses through th Valley.

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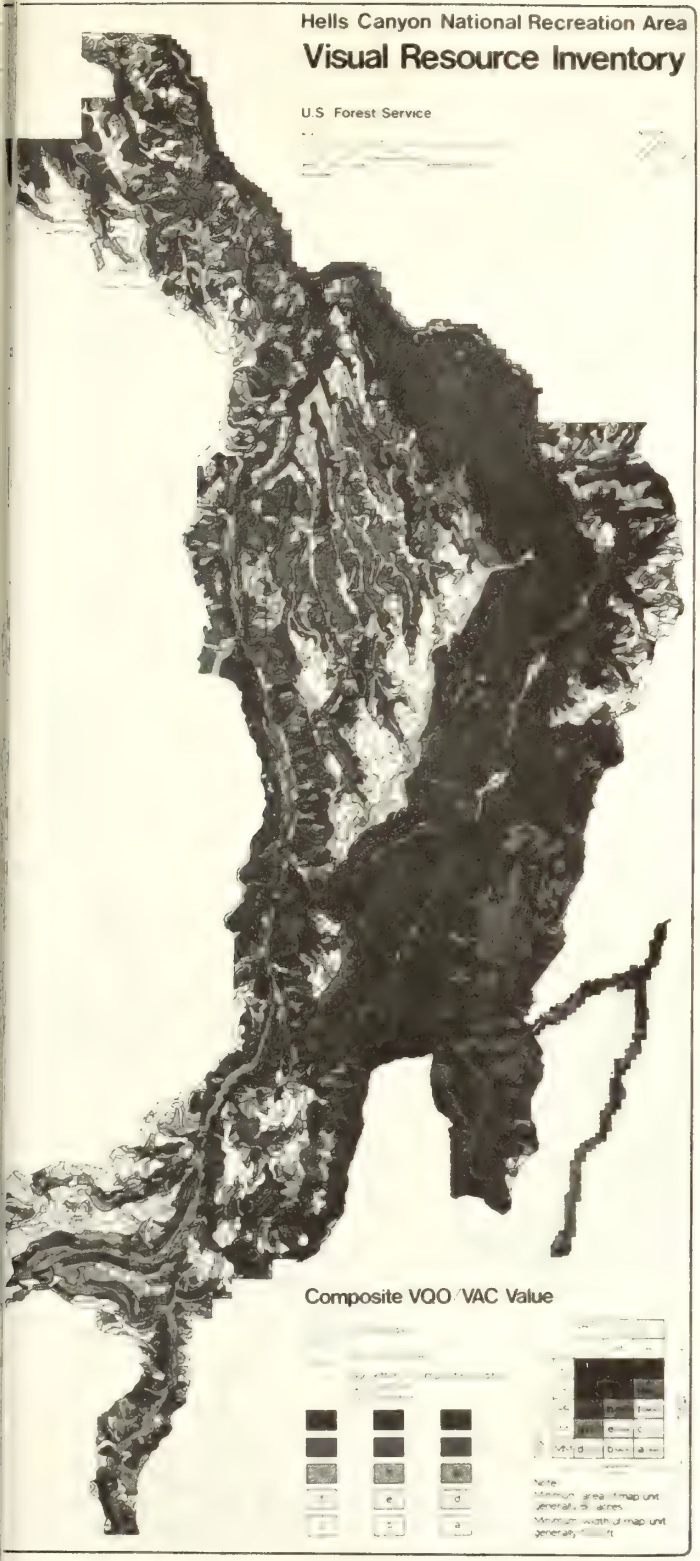
*See color illustration on page 393.


Hells Canyon National Recreation Area
Visual Resource Inventory
U.S. Forest Service
Composite VQO/VAC Value

Map 5. Composite VQO/VAC Value

The sequential views from the road (and the previous three sets of data maps) reveal two important points about the Imnaha Valley.

(1) It is relatively consistent in character. Although there are some locations that give more extensive views than is general, mostly these views do not consist of exceptional or unique combinations of form, line, color and/or texture. They merely reveal more than usual of the typical Valley floor, not of any unique land form in the Valley itself.

(2) Cultural patterns dominate the Valley and determine its visual character. This is especially true in the central segment of the corridor, between the two main lateral roads that give access to it; that is, the road from the south that enters the Valley nine miles from its south end and the road from Joseph to the community of Imnaha. This is the segment that will probably receive the most recreational use. The natural features of the Valley, as seen from this segment of the road, serve mainly to complement the cultural patterns.

The above two observations lead to the conclusion that the most effective means of influencing the visual character of the Valley is not the outright protection of a few critical areas, but rather the maintenance of effective controls on all cultural developments, on a site specific basis, as they occur at any point along the Valley corridor.

Figure 5 illustrates four examples of developments that fit well into their environments.

Figure 6 is an example of existing developments that may be considered visually intrusive. Suggestions for improvements that could reduce visual intrusion are made and illustrated.

Figure 4

Sequential Views Moving North (South Half)

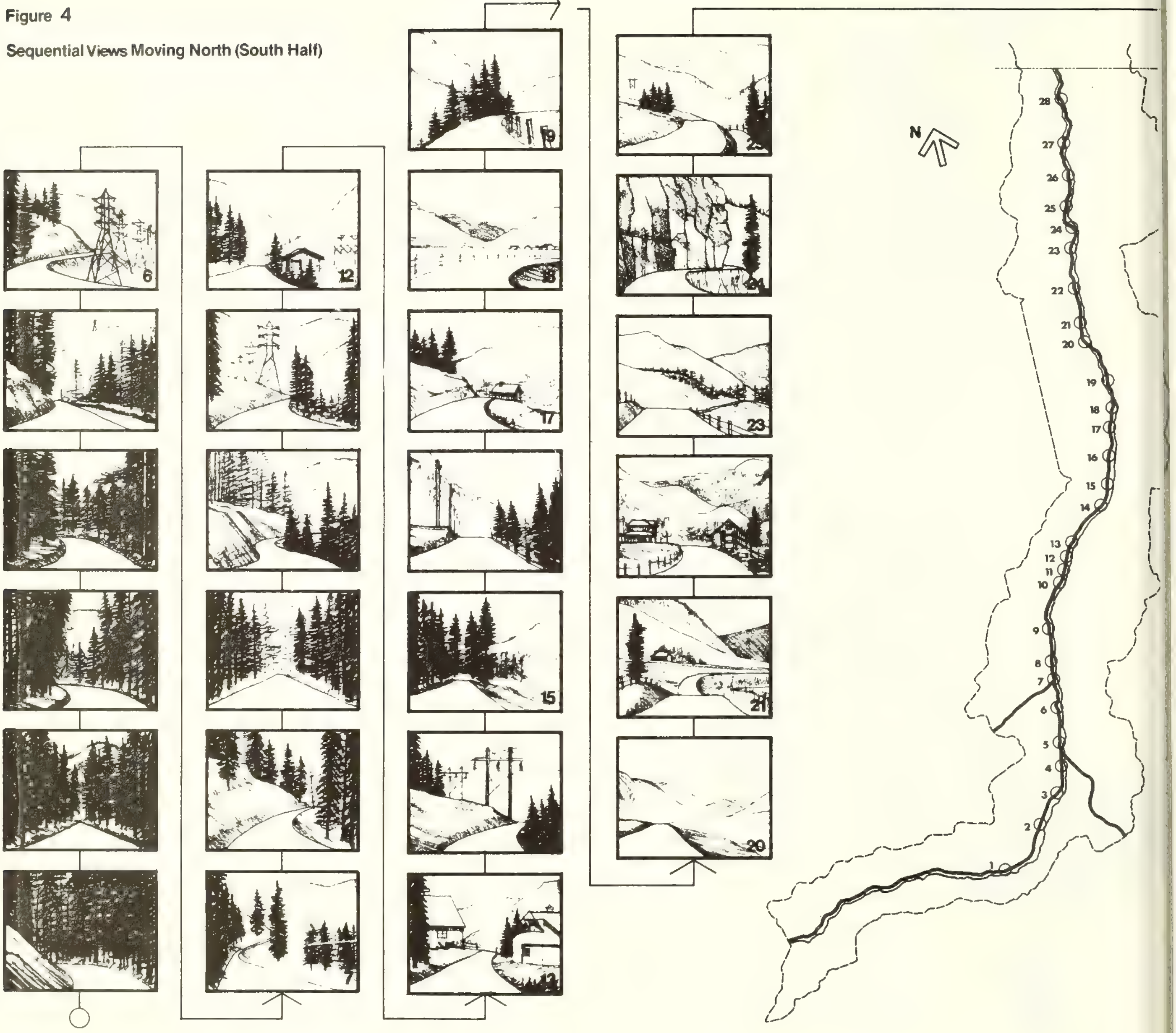


Figure 5 Visually Attractive Development

BARN

This small barn illustrates several of the characteristics that help a building fit into the Imnaha Valley setting. Its style is typical of the older buildings in the Valley. The barn is relatively small in size, dark in color, simple in form, faced entirely in natural materials and closely related to a backdrop of trees.

FEED LOT

This feed area, though unusual in shape, is of typical size. From the visual point of view, it is entirely appropriate as a working element in the visual environment of the Valley. The fence is simple, functional and direct in design.

OLD RESIDENCE

This old and apparently unoccupied ranchhouse is an example of the original style of residence used in the Valley. Its steeply pitched shingled roof and dark timber faced walls harmonize perfectly with the dominant colors, textures and forms in the surrounding landscape. The building is, like the barn illustrated above, small in scale, simple in form and closely related to massed vegetation which visually ties it to its surroundings.

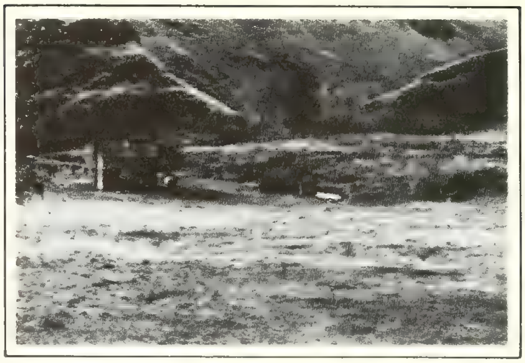
NEW RESIDENCE

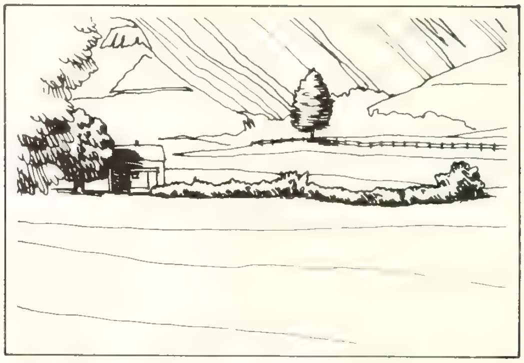
This relatively new residence (in the near middleground, right of center) is not finished in natural materials to the same extent, but it fits into its surroundings extremely well. The pitched asphalt tile roof is a subdued dark green and harmonizes with the color of the woods in the background and the form of the Valley slopes. The house is unobtrusively sited and visually related to its immediate surroundings by the planting, generally natural in appearance, around it.

Figure 6 Buildings

SMALL SCALE BUILDING

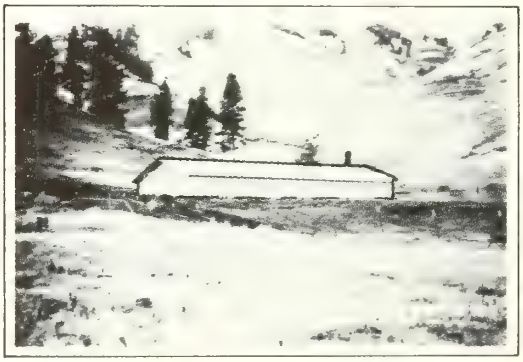
The location of this small building in an open grassy area, not closely related to significant vegetation masses, is visually somewhat intrusive and leaves exposed to view outbuildings, propane tanks and stacked construction materials. It could be improved in two ways by the addition of plant material; the small elements would be screened and the building visually tied to its environment.

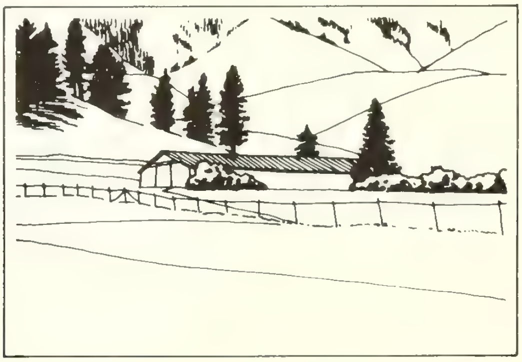




LARGE SCALE BUILDING

This modern metal-faced barn. though larger than most buildings in the Valley, is simple, functional and well designed. It would fit better into the visual environment if its roof were darker in color. Planting one or more tree and shrub masses, partly in front of the building (as seen from the main Valley road) would break up its large bulk and relate it to the surrounding land forms.





The Use of Computer Graphics in the Visual Analysis of the Proposed Sunshine Ski Area Expansion[1]

Mark Angelo[2]

Abstract: This paper describes the use of computer graphics in designing part of the Sunshine Ski Area in Banff National Park. The program used was capable of generating perspective landscape drawings from a number of different viewpoints. This allowed managers to predict, and subsequently reduce, the adverse visual impacts of ski-run development. Computer graphics have proven, in this case, to be an effective and economical tool in ski-area design.

BACKGROUND

In 1977, the Sunshine Village resort was given permission by Parks Canada to proceed with an expansion plan for the Sunshine Ski Area. This expansion was to include a new gondola, several new ski runs and numerous visitor facilities. Prior to construction, however, a working plan was required that would minimize adverse environmental impacts resulting from the new developments. Of these, the effects of expansion on the visual resource were considered by all to be of utmost importance. This becomes apparent when one realizes that summer use of the area is increasing rapidly due to the availability of all season facilities (fig. 2). Furthermore, most of the area to be developed is visible from the village as well as from numerous hiking trails, the most notable of which is the Egypt Lake - Mt. Assiniboine trail corridor (fig. 3). With these considerations in mind, it was decided that the most effective means of assessing and reducing visual impacts should be applied to this area, and the use of computer graphics as a predictive analysis tool was determined to be appropriate. This technique has previously been applied to timber harvesting and hydro line design, but the Sunshine project would be its first application to the more detailed needs of ski area development.

PROJECT SUMMARY

The initial step of this particular project was to outline the proposed expansion area on a 1" to 200' topographic map (fig. 1). Once this was completed, the map contours and appropriate vegetation data (obtained from air photos and on-site observations) were digitized and incorporated into the PREVIEW computer graphics system developed by Wager and Myklestad (1976) recently modified by Angelo (fig. 4).

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[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Mark Angelo is an instructor in Forest Recreation at the British Columbia Institute of Technology in Vancouver, British Columbia, Canada.

Following this, locations of both runs and lifts were chosen as to their suitability for skiing, and then delineated on the topographic map. Coordinates of the clearings were added to the existing data base and graphic drawings illustrating perspective views from selected vantage points were produced.

These drawings were carefully reviewed as they allowed managers to predict the visual impact of the proposed expansion project. During this analysis, those areas where impacts were considered to be unacceptable were designated, and new treatments (i.e., glading, reduced clearing widths, feathering of edges, etc.) were prescribed. After several computer runs, an acceptable visual management plan was obtained (figs. 4-11).

The cost of using computer graphi in this particular project was very reasonable, but it does tend to vary somewhat depending on the equipment. In this case, using an IBM 370 with calcomp plotter, each individual drawing was estimated to cost $15-$17. Th initial digitizing of the topographic data was our only major expenditure costing approximately $175 for a 4000' by 5000' area.

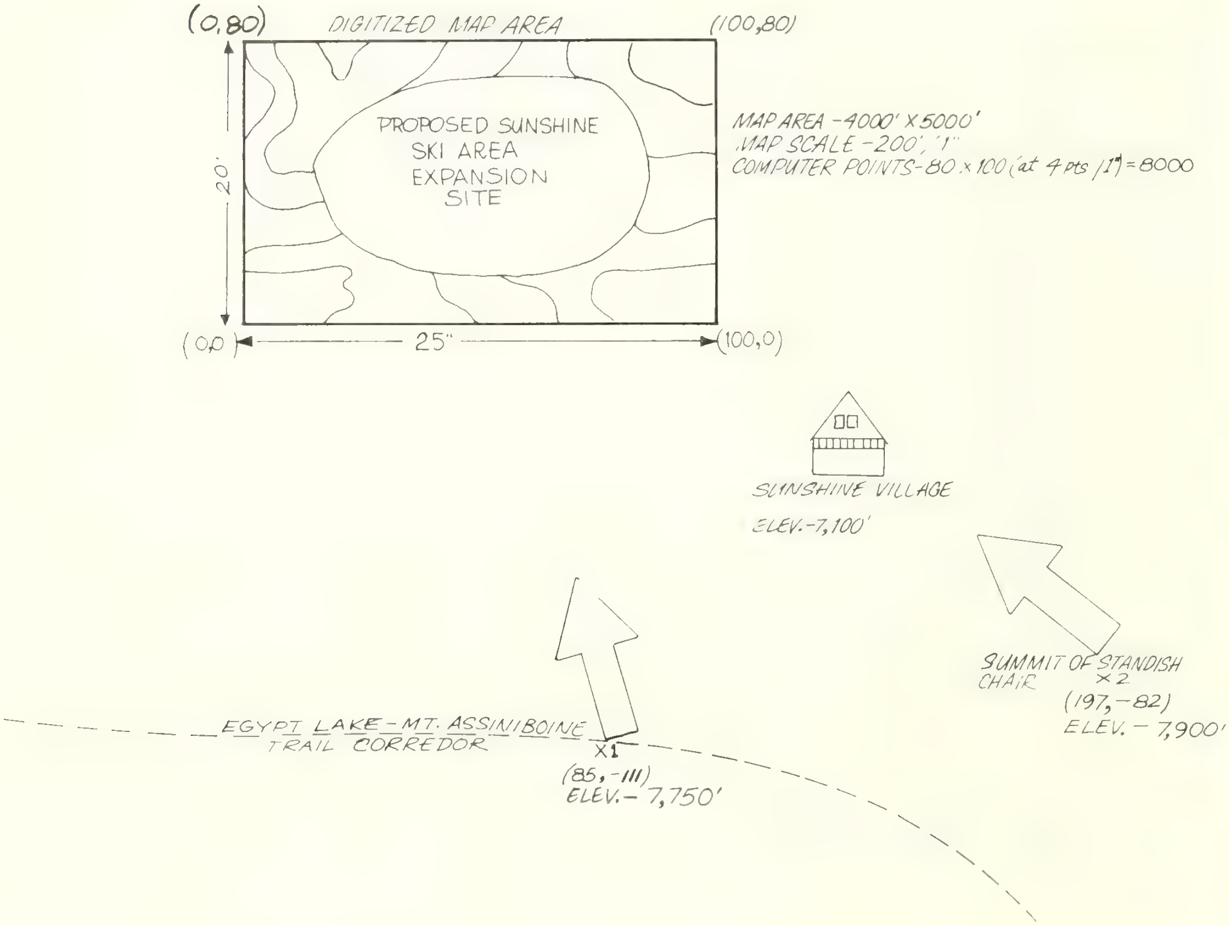

Figure 1. Perspective views of the proposed development were generated from points X1 and X2. These locations were not within the digitized map area and hence, elevations as well as the usual coordinate data had to be supplied.

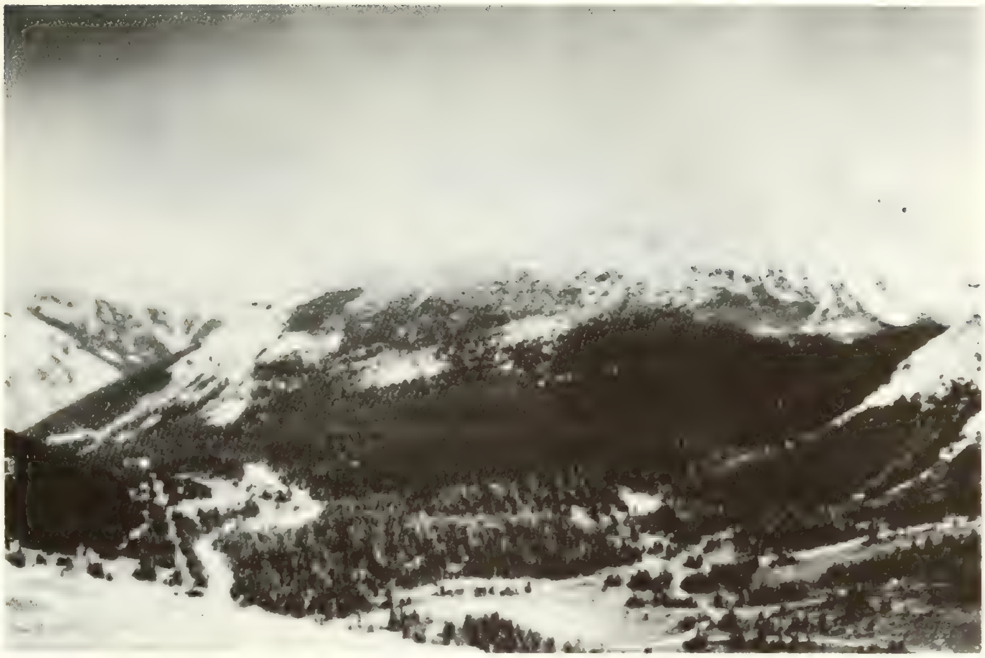

Figure 2. This picture of the proposed expansion site (which encompasses the two large openings on the far ridge) was taken from the top of the Standish Chairlift, which is becoming a very popular all season facility.

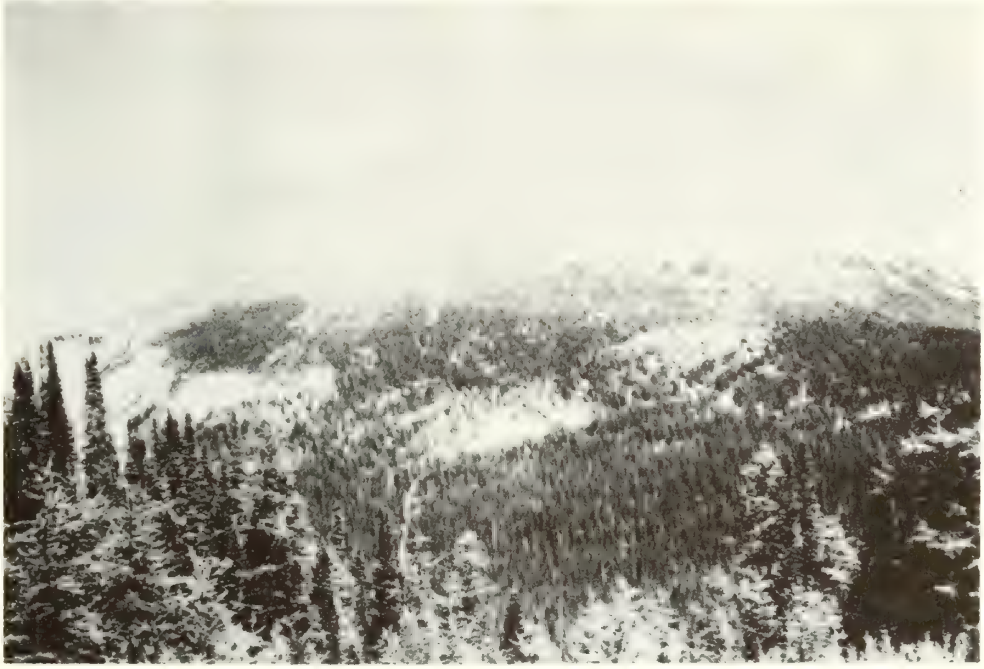

Figure 3. This is a view of the same area from a point along the popular Egypt Lake - Mt. Assiniboine trail corridor on Wawa Ridge.

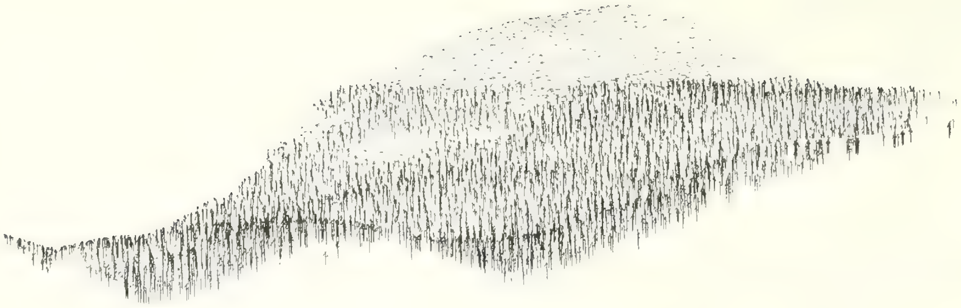

Figure 4. The incorporation of vegetation data into PREVIEW (as seen in this cover drawing of the expansion site from Mr. Standish) did prove to be a slightly repetitive procedure. The original program required that an entire area be designated as one vegetation type on a 2-A card, and any corrections (i.e., differe cover symbols, varying densities, etc.) were then added on 2-B cards. This process was later modified so that additional 2-A cards could be used thus enabling program users to designate changing surface or cover types more rapidly.

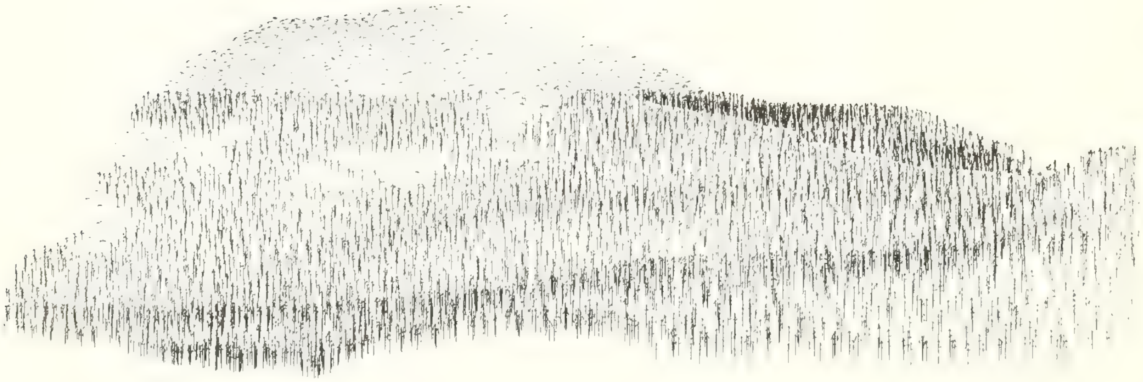

Figure 5. In this vegetative cover drawing from Wawa Ridge, the author attempted t include several areas that were outside the boundaries of the original digitized map area. This was accomplished by digitizing the adjacent area, and then overlapping t two drawings. The darker section in the upper right corner of this particular graph is part of the second drawing.

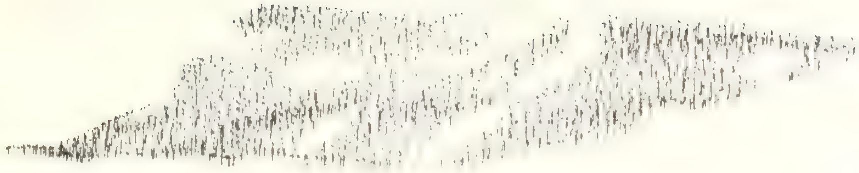

Figure 6. This graphic illustrates how one of the more popular extension proposals would appear to visitors on top of Mt. Standish. Visual impacts were still not totally acceptable however, and further modifications were required.

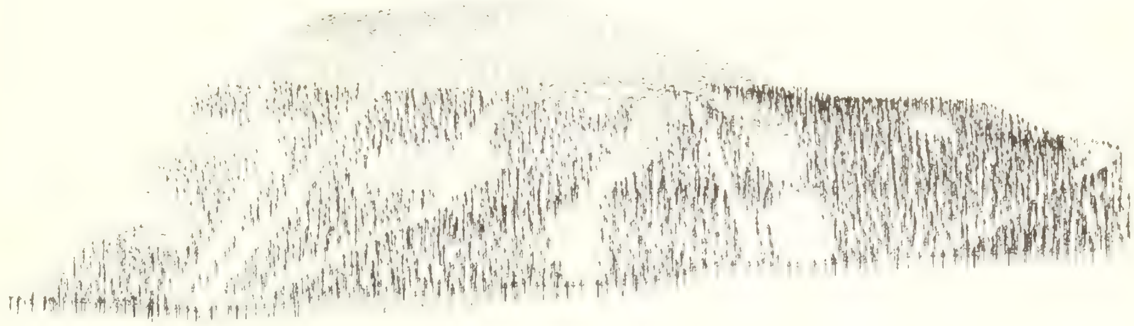

Figure 7. The proposal referred to in Figure 6 would appear this way to hikers on part of the Egypt Lake - Mt. Assiniboine trail.

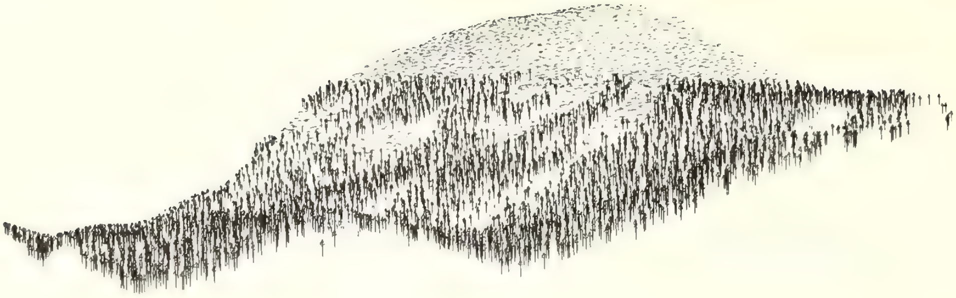

Figure 8. After several modifications, a final proposal was accepted in which adverse visual impacts were reduced through glading, feathering of edges, reduced clearing widths at selected locations, and the protection of vegetation between towers. It should be noted that the forest communities existing on the site (i.e. all-aged stands of larch-fir and spruce-fir) were conducive to these treatments.

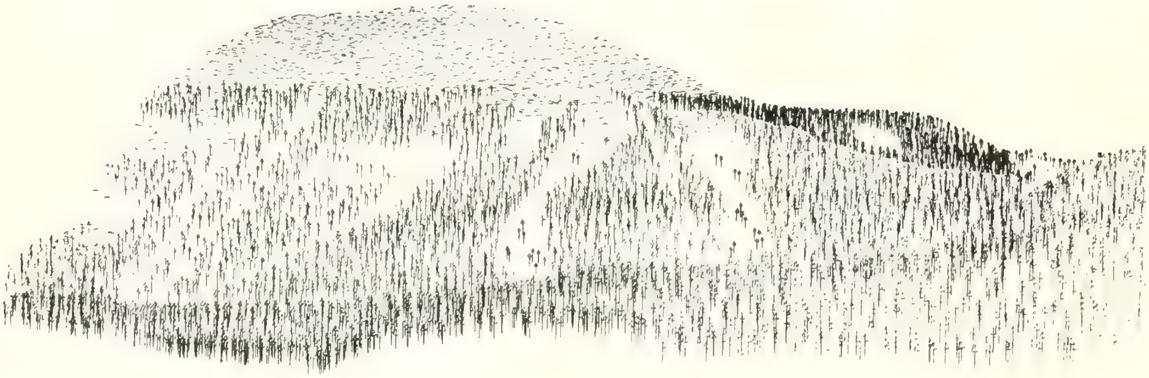

Figure 9. Despite attempts to conceal certain openings, some runs remain easily seen from parts of the trail. Yet, negative impacts on the landscape will be minimized through the use of helicopters (for both logging and construction), over-the-snow removal of debris, and selected seeding where necessary.

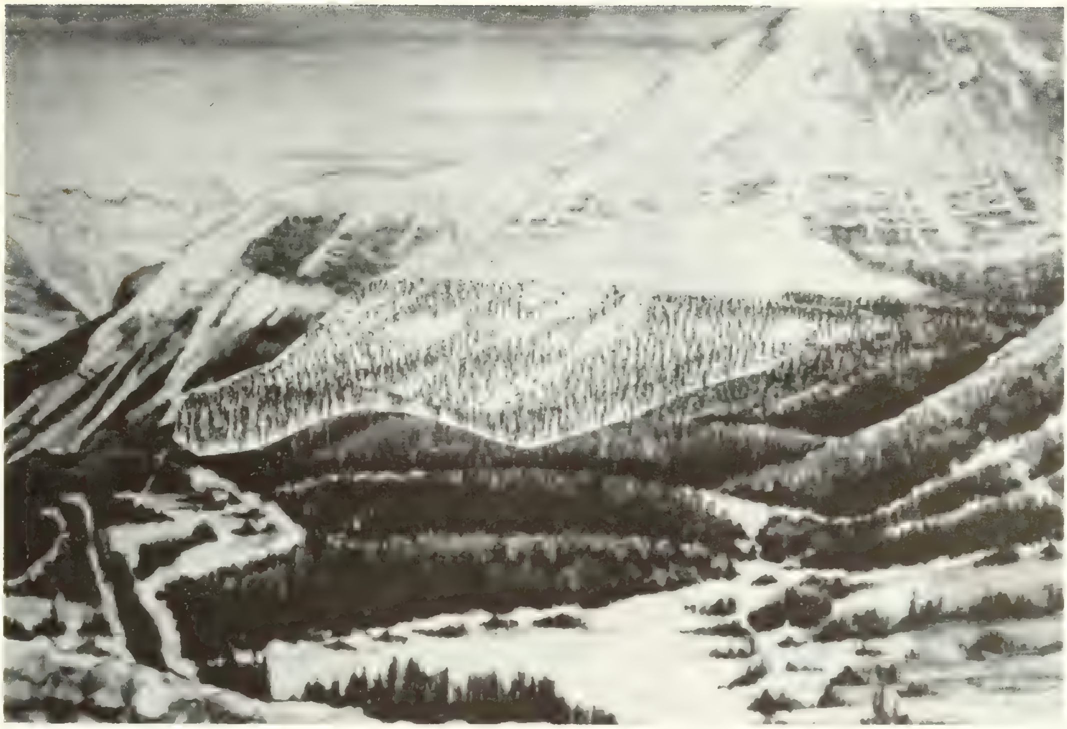

Figure 10. Graphics illustrating run location were placed within an artist's sketch of the surrounding landscape so that managers could more accurately predict the visual impacts of development.

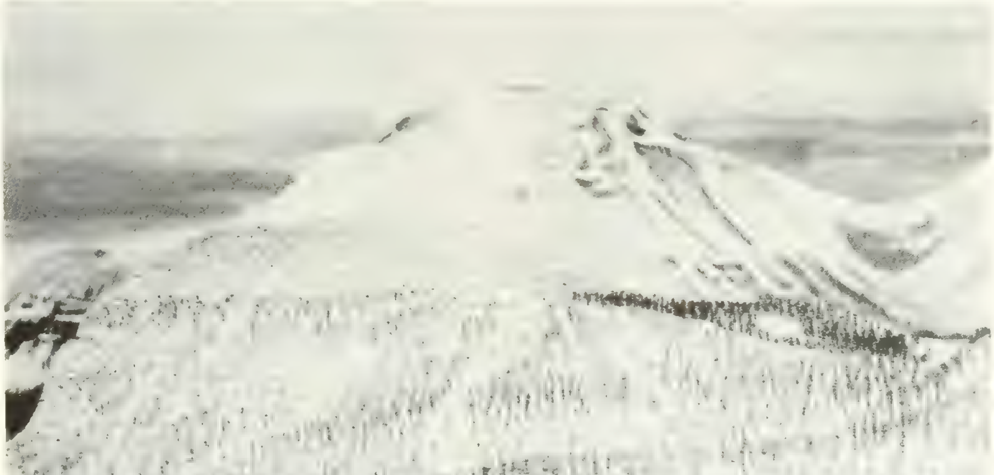

Figure 11. See Figure 10.

CONCLUSION

Computer graphics is a viable and economic method of assessing visual impacts of selected landscape alterations. Prior to the development of this technique, managers simply did not have access to an accurate and efficient means of predictive landscape analysis. This is not to imply that computer models are the only solution to landscape analysis problems, but if access to suitable equipment can be obtained, programs like PREVIEW can allow the manager to generate a number of perspective views in a very short period of time.

Despite its effectiveness however, users of this, and similar computer systems should be aware of a problem that may be encountered when assessing the quality of computer drawings. This stems from the way vegetation is initially incorporated into the program. Simply stated, vegetation symbols used in PREVIEW are randomly spaced around selected points, and sometimes, visual impacts don't appear as harsh on the graphic model as they may appear on the ground. Yet, if small scale drawings are used in conjunction with photographs, maps, and on-site observations, this effect can easily be minimized.

Listings and instructions for using PREVIEW are available from:

Recreation Research Project,
Forest Service, USDA,
c/o State University of New York,
College of Environmental Science
& Forestry,
Syracuse, New York
13201

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ACKNOWLEDGEMENTS

The author acknowledges the contributions of Alan Peatt and Barbara Hobson in applying and modifyi the computer program. Thanks is also extended to Don MacLaurin of B.C.I.T. and the Sunshine management staff for their valuable on-the-ground assistanc All illustrations and art work utilize in this report were contributed by Ray Young and Isobel MacLaurin. Final the author extends his gratitude to th British Columbia Institute of Technolo for allowing access to their computer facility.

Appropriate Combinations of Technology for Solving Landscape Management Problems—

Session H: Rural and Agricultural Development

Managing for Naturalness in Wildland and Agricultural Landscapes[1]

Joan Nassauer[2]

Abstract: Visual management systems operate from the premise that people have expectations for landscape views, and that people's positive expectations should be fulfilled. Both the Forest Service and Bureau of Land Management visual management systems assume that people expect wildlands to look natural.

People also like to see natural landscapes in rural Iowa. Research I conducted in 1977-78 showed that naturalness, land use compatibility, water presence, and relief predict 75 percent of the variance in visual value of Iowa landscape views. Naturalness alone predicts 50 percent of the variance in visual value.

People may have different expectations for naturalness in the context of an agricultural landscape than in a wild landscape. Although the agricultural landscape is of natural materials, it is also a landscape of designed patterns. The wild landscape displays natural materials in natural patterns. Differences in expectation should lead to different visual management approaches.

NATURALNESS IN THE VISUAL LANDSCAPE

People prefer the visual quality of natural landscapes. Zube, Pitt, and Anderson's study of the Connecticut landscape (1974) and my own study of the Iowa landscape (1978) support this assertion. The Forest Service and Bureau of Land Management visual management systems are based on this idea. Thinking about how people see naturalness in landscape may help us develop sound visual management goals.

People may enjoy seeing a natural landscape because the landscape communicates the concept of naturalness. Naturalness is a concept which has no specific appearance in form; line, texture, and color of naturalness change from place to place. These formal visual qualities seem not to account for the power of naturalness as a predictor of visual preference. Because perception and cognition of a landscape are not discrete events, landscape meaning may be more important than specific appearance in understanding people's visual preferences for natural landscapes.

What naturalness is may be impossible to determine. Yi-Fu Tuan reports that Basil Wiley noted 60 different meanings of the term (Tuan 1971). In both Zube, Pitt, and Anderson's study and my own, naturalness was operationally identified as being a function of land use type, and ranked land use types predicted visual preference. In Zube, Pitt, and Anderson's study, land uses were ranked by agreement of nine planners and, in my own study, land uses were ranked by reference to typical proportion of impermeable surface. Explaining the ranking for both studies as a description of the typical degree of control by people for any given land use seems to make intuitive sense. Research described below demonstrates that this common sense notion of naturalness is empirically related to people's preferences for landscape views. Adopting this operational definition of naturalness as a function of land use and

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Assistant Professor, Department of Landscape Architecture, University of Illinois, Urbana, Illinois.

and as reflecting the degree of control by people may be useful in thinking about regional visual management.

NATURALNESS IN THE IOWA LANDSCAPE: A STUDY

Hypothesis and Definitions

In a 1978 study of people's visual preferences for the Iowa landscape, I hypothesized four landscape characteristics to be positively associated with visual value and found naturalness to be by far the most powerful predictor. Visual value was operationally defined as the mean score of 150 people's evaluations of a given landscape view. Naturalness was operationally defined as the typical proportion of impervious surface of a given land use. In addition to naturalness, water presence, topographic relief, and land use compatibility were tested as predictors of visual value. Water presence was operationally defined as the visible presence of surface water; topographic relief was defined as the characteristic slope of the most prevalent visible landform; and land use compatibility was defined as similarity in naturalness of spatially adjacent land uses. Amount of presence of each of the four landscape characteristics was categorized by an ordinal scale (table 1).

Research Technique

An original sample of 152 slides depicting Iowa landscapes was selected to represent the range of categories for the four landscape characteristics and all possible combinations of the categories. That range was achieved with the exception of some combinations of landscape characteristic categories unlikely to be found in Iowa. Slides were selected to control several factors that might influence evaluations of visual quality: slide quality, slide orientation, viewer eye level, season, weather, diurnal changes, presence of animals or people, number of land uses, and distance of view.

To verify the presence of the categories of landscape characteristics in the slides, they were shown to three agronomists, three geologists, and three landscape architects. Each of the viewers was asked to categorize the landscape characteristics seen in the slides according to the operational definitions given above. The Chi-Square Test for goodness-of-fit was used to compare the number of viewers who agreed on the category of a characteristic shown in a slide with the number of viewers who might agree by chance. The number of viewers who agreed was significantly greater than chance on all four characteristics for 82 of the slide views. These 82 slides composed the sample of views for the remainder of the study. The number of slides in each of the landscape categories is described by Table 1.

147 students and 3 instructors at Iowa Sta University evaluated the visual quality of landscapes shown in the 82 slides. The participant were chosen to represent a range of possible occupational biases in landscape evaluation; 47 were landscape architecture majors or instructo 20 were farm operations majors or instructors, and the remaining 82 came from a wide variety of other majors.

Five groups of participants viewed the sli in three different random orders. T-tests of the difference of mean scores for each view showed slide order to have no effect on visual evaluations. The participants were asked to "Evaluate each view according to its visual quality relative to all other Iowa landscapes you know. Don't think about its quality for a particular activity (say, traveling, or a place to live). Think only about its quality as a view...record your first impression. Do not sto to consider your answer." Participants were asked to rate the visual quality of each view on a scale from 1, very high, to 7, very low. Each slide was shown for 10 seconds.

Data Analysis

Scores for visual value were determined by finding the mean visual quality score for each view. Mean scores for the views ranged from 1.76 to 6.00. All but ten of the views had a range of evaluations from 1 to 7, but standard deviations for the mean scores fell consistently between 1.2 and 1.6.

Each landscape category for all four landscape characteristics was treated as a nominal variable. For example, the presence or absence of the agricultural naturalness category was coded instead of the second highest level of naturalness, agricultural land use, being coded. In this way, the order of categories within landscape characteristics, as they empirically related to visual value, could be observed. Each of the four landscape characteristics was regressed alone on visual value, without controllin for the effects of the other landscape characteristics; and all of the landscape characteristics were regressed together on visual value, controlling for interactions among landscape characteristics.

Nonstandardized regression coefficients for the categories of each of the four landscape characteristics described the order of the categories (table 1). The naturalness categories

Table 1--Landscape Characteristic Categories: nonstandardized regression coefficients

Landscape Characteristic Category	n	Controlled	Uncontrolled	Mean
Naturalness				
Nonagricultural	30	- 1.51	- 2.00	2.96
Agricultural	27	- 1.20	- 1.41	3.56
Residential	8	- 1.15	- 1.12	3.88
Industrial	6	0.09	- 0.01	4.95
Commercial	11	0	4.96	4.96
Compatibility				
Same	51	- 0.41	- 0.39	3.60
Compatible	15	- 0.56	- 0.49	3.50
Incompatible	16	0	3.99	3.99
Water Presence				
Water visible	29	- 0.57	- 0.97	3.03
Water not visible	53	0	4.00	4.00
Topography				
Strongly sloping	10	- 0.62	- 1.39	2.87
Varying	38	- 0.28	- 0.95	3.31
Nearly level	34	0	4.26	4.26

were ordered as expected, but regression coefficients of the commercial and industrial categories were very similar, suggesting that the visual value of the two land uses is similar. Contrary to expectation, regression coefficients of the land use compatibility categories showed that views of two compatible land uses were valued over views of a single land use. However, in general, nonstandardized regression coefficients for all the landscape characteristic categories confirmed the expected order for visual value. The main hypothesis, that the four landscape characteristics were positively associated with visual value, was tested by regressing all of the landscape characteristic categories and all of their two-way interactions on visual value. An initial step-wise regression included 28 of 37 possible terms and explained 75% of the variance in visual value. This initial regression showed that the four land use characteristics and their interactions were highly significant in predicting visual value.

A classical analysis of variance, described below, isolated the effects of each of the landscape characteristics from those of the interaction terms and allowed each characteristic to be evaluated separately. All of the terms in the analysis of variance were significant at the .01 level of probability except land use compatibility, which indicates that compatibility is not an important predictor of visual value.

Source of variation	Mean square	F
Saturated model	.7463/28 = .0266	5.5417
Additive model	.6285/9 = .0698	14.5417
Naturalness	.5054/4 = .1264	26.3230
Compatibility	.0266/2 = .0133	2.7708
Water presence	.2007/1 = .2007	41.8125
Landform	.2640/2 = .1330	27.5000
Interaction	.7175/23 = .0312	6.5000
Residual	.2537/53 = .0048	

The final regression equation did not include the compatibility characteristic and treated the commercial and industrial land use categories of naturalness as a single category. This equation, a partial stepwise regression entering the naturalness, water presence, and topographic relief characteristics first, and their two-way and three-way interactions second, showed naturalness to be the most significant characteristic, explaining 50 per cent of visual value. This final equation is described below.

Independent variable	R^2
Nonagricultural land use	0.26
Agricultural land use	0.42
Residential land use	0.50
Water presence	0.56
Steep topography	0.58
Varying topography	0.59
Interaction of nonagricultural land use and water presence	0.63
Interaction of residential land use and varying topography	0.64
Interaction of residential land use and water presence	0.65
Interaction of nonagricultural land use, water presence, and varying topography	0.65
Interaction of water presence and steep topography	0.66

Implications

The most important finding of this study is that naturalness of land use type is a powerful predictor of visual preference. Specifically, the study found that people have visual preference for land uses in the following order of their naturalness:

1. Non-agricultural open space
2. Agricultural land
3. Residential land
4. Commercial or industrial land

Results of Zube, Pitt, and Anderson's lan mark study of the Connecticut River Valley (197 are consistent with this finding. Both studies examined visual preference for primarily rural landscape regions; the Forest Service and Burea of Land Management describe naturalness as a determinant of visual quality in wildlands as well. The first premise of the Forest Service Visual Management system is that, "People expec to see a naturally appearing character" within forest areas (Forest Service 1974). The Feder Land Policy and Management Act of 1976 directs the Bureau of Land Management to manage the lanc scape with concern for "natural scenic values." Although naturalness has positive visual connotations in both wildlands and agricultural lands it may have distinct meanings and implications for visual management in each of the two landscape types.

EXPECTATIONS FOR NATURALNESS

The Land Use Context of Naturalness

Defining naturalness as the typical degree of control by people for a given land use helps us make sense of the order of the land uses in the Iowa study, but it does not tell us what qualities of the land use communicate the concep of naturalness to the viewer. Each land use implies a different level of naturalness and visua preference, but it may also imply a different image of naturalness. To manage nonagricultural

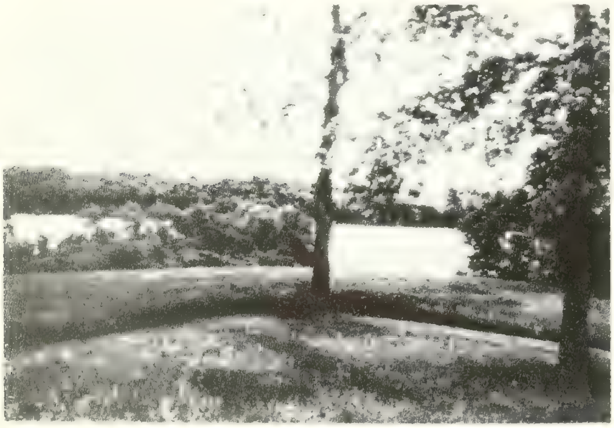

Figure 1--Nonagricultural open space

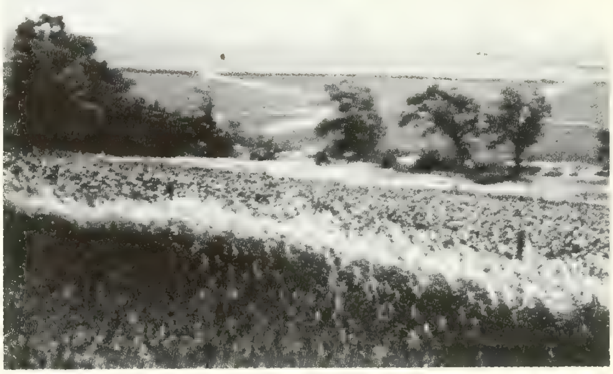

Figure 2--Agricultural space

open space or agricultural lands we need to know what naturalness means to the viewer in each land use context. We need to know what people expect naturalness to look like in wildlands and agricultural lands.

Our criteria for judging the visual quality of any given landscape may be qualified by our original expectation for the naturalness of the land use; the less natural the land use, the less our visual criteria are derived from the expected appearance of naturalness. So a forest may be more beautiful than agricultural land simply because it is a forest; but at the same time, we expect the forest to be beautiful in a different way than agricultural land simply because it is a forest. Between perception (this place is a forest) and expectation (this place should be beautiful in the way forests are beautiful) lies an interpretation of naturalness for a specific land use. Naturalness may mean the appearance of unimpeded ecological succession in one setting, but may mean only the presence of growing corn in another setting. The wildland context indicates a different interpretation of naturalness than does the rural context. Recognizing the deepfelt meaning of naturalness in any landscape context, we can also recognize that the specific meaning of naturalness may change with landscape context.

Wildlands as Archetypes of Naturalness

John Dewey says in Art as Experience that, "While the roots of every experience are found in the interaction of a live creature with its environment, that experience becomes conscious, a matter of perception, only when meanings enter it that are derived from prior experience" (Dewey 1958).

Several theorists see wild or natural environments as archetypes of meaning which are carried not only into the interpretation of other environments but also into other forms of experience. Jay Appleton (1975) argues that people's ancestral experience in natural environments taught or caused the evolution of a preference for environments that provide visual control of the environment or that provide shelter from environmental threat. Appleton suggests that natural environments are likely to be most visually appealing because they are likely to have the greatest potential for prospect and refuge. Paul Shepard (1967) sees wilderness as the landscape archetype of acceptance of natural systems. He notes that "The spiritual effect of the wilderness runs deeper than any other encounter in nature," and that people's response to wilderness has varied from the revulsion of 16th century Protestants to the reverence of the Transcendentalists. Yi-Fu Tuan links current interpretations of nature with two ideologies, environmentalism and ecology. Both ideologies interpret nature as the ultimate external authority, a kind of parallel to anthropomorphic notions of God. Thus, the effects of nature and natural systems are inherently good. It follows that landscapes that reveal the unimpeded actions of natural systems are also inherently good, and that the landscape of greatest appeal in our time and culture is the wilderness.

Viewed from the theoretical standpoints of any of these writers, wildlands are archetypes of powerful forces outside the control of people. Like the 18th century English notion of the

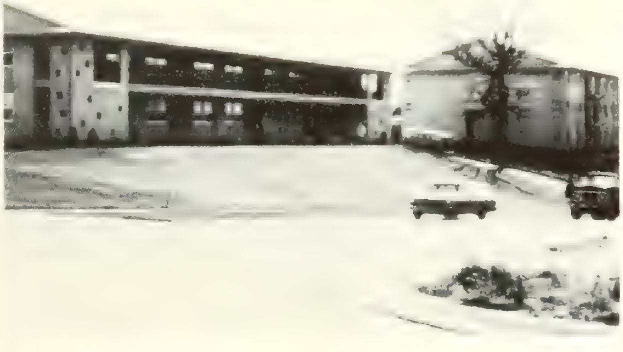

Figure 3--Residential space

Figure 4--Industrial or commercial space sublime, wild landscapes disallow the appearance of human intervention. The sublime was the wonderful and tremendous in nature. It was too large to be experienced by the senses; perceiving the sublime was an attempt to embrace infinity. Archetypes of naturalness exclude the appearance of design.

The visual management of wildlands must reject aesthetic artifice. Although we may not fully understand the complex ecological communities of wildlands, we hope the communities are there: our dependence on natural forces outside our control has deep meaning for us. Though we might be able to establish the conditions which will allow a natural ecological community to evolve over time, such a landscape cannot be had by design fiat. Nor does imitation of visual qualities of natural objects satisfy our expectation for wild landscapes. The only way we can have such landscapes is to select them from the existing landscape to be protected from human design. We select these landscapes for ourselves, but we also select them as authentic archetypes for future people's ideals. And it seems that the appropriate criteria for such selection are not visual, but biological, because in wildlands the visual image communicates the meaning of the biological ideal.

Agricultural Landscapes as Designed Landscapes

What meanings enter into the perception of agricultural landscapes? The agricultural landscape suggests naturalness limited and portrayed by human intention; viewers expect the imprint of human activity on this landscape. It is by definition a landscape of natural materials, but a landscape designed by people. It uses natural systems, but it does not control them. Agricultural landscapes have a dual meaning: they are natural and they are artificial. They must be preserved and created at the same time.

Agricultural landscapes must be preserved in their present use. Agricultural lands provide a special sense of naturalness that is particularly significant because of these lands' visual accessibility from small towns and suburban areas and from our nation's highways. The first goal of visual management of agricultural lands must be to assure that this accessibility to a natural environment from the everyday built environment continues.

The visual management of agricultural lands should also encourage the creative exercise of aesthetic artifice. Artistic interpretation of the relationship between natural and human forces is appropriate here. Some of the agricultural landscapes that exist today can simply be recognized as found art. Other agricultural landscapes can be preserved in their present use, but changed in appearance to improve their visual quality. These lands can be patterned and judged according to criteria of line, texture, and color because the agricultural landscape is essentially designed. Visual management of the agricultural landscape can enlarge the purpose of the agricultural design to include aesthetic pleasure.

Visual Management Techniques: Creation and Selection

While we need to recognize naturalness as a primary overriding determinant of visual value in both wildlands and agricultural lands, people may have different expectations for naturalness in each case. It follows that agricultural lands and wildlands should be managed differently. Agricultural landscapes display natural materials in artificial patterns; the lands must be preserved in this present use, but the patterns can be created. Wildlands display natural materials in natural patterns; these lands must be selected for preservation from the appearance of design. Criteria for judging the visual quality of each landscape type should incorporate this crucial distinction between creation and selection.

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Visual Resources of the New Jersey Pine Barrens: Integrating Visual Resources into the Planning Process[1]

John W. Sinton
with the assistance of
Geraldine Ginder[2]

Abstract: The first purpose of this study was to determine the visual quality of New Jersey Pine Barrens forests according to residents of the area. The goal of the study was to determine how to manage Pine Barrens forests to obtain high visual quality within the framework of residents' preferences, available by the Federal Omnibus Parks Acts of 1978 and proposed New Jersey state legislation establishing a Pinelands Commission and planning region.

A small number of long-time residents of Washington Township, Burlington County, in the heart of the Pine Barrens, were asked to map sites of high and low visual quality. These residents took the investigators on field trips to photograph their sites, and the photographs then were shown to 20 township residents who ranked them from highest to lowest visual quality.

Forest management techniques, such as various types of cutting, burning, and herbicide applications, were researched. Finally we analyzed the feasibility of employing local residents to manage Pine Barrens forests under the quidance of the New Jersey Division of Parks and Forests, and the Pinelands Commission.

Results indicated that lowland forests of Atlantic white cedar, the most difficult forest type to obtain, ranked highest. The most important conclusion, however, is that residents like a diversity of landscapes rather than any one type. Management techniques and costs are much higher and more sophisticated for lowland than upland forests. We determined that it is feasible to employ local residents to manage forests for visual diversity.

INTRODUCTION

This study addresses three questions:

1. What are the visual preferences of New Jersey Pine Barrens residents for forest landscapes of their region?
2. What forest management techniques are available to achieve preferred landscapes?
3. What opportunities exist to allow local residents to manage their landscapes for visual quality?

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[1] Presented at the National Conference on Applied Techniques of Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979. A second article on institutional and management techniques and costs is in preparation.

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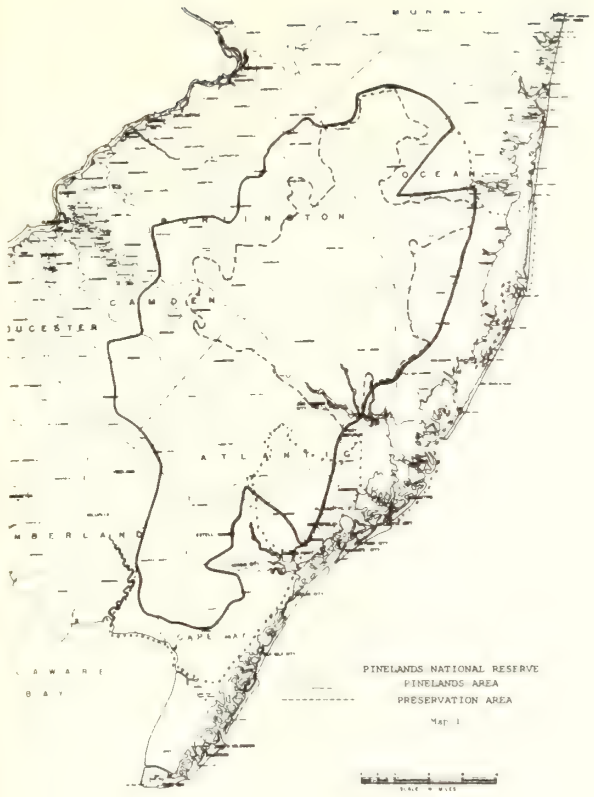

Map 1

Background

Geography

The study area we have chosen is Washington Township, Burlington County, New Jersey (Map 1). We chose this 100-square-mile area because it is in the central part of the Pine Barrens, it has not been subject to intense agricultural or residential development and the majority of its 650 residents have spent more than half of their lives in or near the township.3/ The landscapes of the township represent almost all variations of forest types and age in the Pine Barrens from bogs to mature stands of cedar, pine and hardwoods.

The New Jersey Pine Barrens cover 2,000 square miles and forms part of the Atlantic Coastal Plain which stretches from Cape Cod to Florida. The Pine Barrens' outstanding feature is its sandy soil which supports acid-tolerant plant and animal species. Lowland areas support forests of Atlantic white cedar (*Chamaecyparis thyoides*) or swamp hardwoods composed of red maple (*Acer rubrum*), black gum (*Nyssa sylvatica*), and sweetbacy (*Magnolia virginiana*); transitional sites in early successional stages grow thick stands of pitch pine (*Pinus rigida*), while uplands support a mix of pitch and shortleaf pine (*Pinus echinata*) and various species of oak (Quercus sp.). Although mature successional stages eventually would produce swamp hardwoods on lowland sites and oak on the uplands, the Pine Barrens has been historically subject to frequent fire and intensive timbering. The result, until the 1940's, has been a diverse series of forest landscapes in various stages of succession. Since the second World War, however, decreased cutting and improved fire control have produced more uniform landscapes in the Pines, which now tend toward climax conditions (Little 1979, Sinton 1978).

Piney Society

Residents of the Central Pine Barrens who proudly call themselves Pineys or Pinehawkers, come from Anglo-Scottish-Irish and Dutch ancestors who settled in the area in the eighteenth and early nineteenth centuries. From 1760 to 1870 rural industries such as iron, glass and paper making provided the economic nexus of the region. In the past century, Pineys developed an economic structure on the periphery of megalopolis which consists of timbering, farming and seasonal jobs. Piney society exists not in isolation, but rather as an adjunct to Philadelphia and regional coastal centers such as Atlantic City and Toms River.

Washington Township residents live in small, family-oriented communities of 20 to 200 people. In the twentieth century their ranks have been joined by people from North Jersey and the Delaware Valley who moved to the area after having been frequent vacation visitors for many years. In Ocean and parts of Burlington Counties, the central core of Piney society has been subject to intense population growth pressures from retirement communities and, in the north and west, commuters from the New York and Delaware Valley metropolitan areas (Ayres 1979, Sinton 1979a).

An Institutional Framework for Planning

Attempts at regional planning for the Pine Barrens began in 1960, but not until the mid-1970's were development pressures sufficient to endanger the water supplies, ecological integrity and recreational potential of the region.4/

3/ Approximately 650 people live in the township. Data on their length of residency come from 6 years of field work in the area.

4/ A brief history of planning attempts in the Pinelands can be found in the Governor's Pinelands Review Committee Report, 1979.

In 1978 Congress passed the National Parks and Recreation Act, also called the Omnibus Parks Act, of which Section 503 was devoted to the establishment of a Pinelands Reserve. Shortly after passage of the Omnibus Parks Act, Governor Byrne's Pinelands Review Committee published its draft of a conceptual plan for the Pine Barrens, or Pinelands, which designated a Pinelands preservation and protection zone as shown on Map 1, and established a Pinelands Commission of 15 members to plan and manage the region. As of April, 1979, legislation to establish a Pinelands Commission is in the New Jersey Senate Energy and Environment Committee, and action is expected by fall 1979 to establish the Commission as a permanent state body.

Local input into planning over the next decade will be critical to the success of Pinelands management; the region's size, its history and political exigencies require local input. Most of the Pine Barrens' 2,000 square miles will be lived in, not preserved for wilderness in the classic sense, and most of the Pinelands must be managed carefully to create habitats for rare and endangered species, game, timber, watersheds and natural resources. The Pines must be managed for those who live in them, and an important part of that living experience is visual.

We, therefore, went to the residents to ask them to identify the visual resources of the Pine Barrens.

RESIDENTS' ASSESSMENT OF VISUAL RESOURCES

Introduction

Pine Barrens landscapes represent human intervention--"ordering" from a historic viewpoint and often "disordering" from an ecological viewpoint. Since we are concerned with management of the Pine Barrens, we followed the advice of Brian Goodey (1974) that "without a prior understanding of the bases of perception and behavior, environmental planning and improvement are mere academic exercises, doomed to failure because they are unrelated to the terms in which people think and the goals they select" (Goodey 1974, p. 33). This project attempts to join the "complex attitude derived from immersion in the totality of the environment" of local residents in the Pine Barrens to the needs of the land-use planner (Tuan 1974, p. 63).

Methods

General

"Attitudes toward the countryside, insofar as they are verbalized and known are sophisticated responses to environment...they presuppose the existence and recognition of environmental types and a degree of freedom to choose among them" (Tuan 1974, p. 248). The Pine Barrens residents we interviewed were descendents of families who have lived off their physical resources for five or six generations, and they have a very sophisticated view of their landscape. Although this research is concerned chiefly with visual resources, in fact almost every person interviewed expressed concern and had concrete perceptions about the use of the landscape, whether for cordwood, sawboards, hunting and fishing, berry picking, wildflowers or picnicking.

The complexity of residents' visions of their landscapes in fact presented a problem because they neither could nor would separate what they saw from how they lived in and worked with their environment. Therefore, the author did not attempt to separate their visual sense from the rest of their human experience, but rather turned to the method of mental mapping as described by Gould and White (1974). This, we hoped, would give us an idea of the general shape and size of the area people used and some outstanding visual features. We then took 35mm photographs representing all different stages of succession, and asked 20 residents to rank the photographs from highest to lowest visual quality (Palmer 1978). Our intent was to take those landscapes with the highest ratings and suggest management techniques for them.

Methodological Problems and Solutions

Like most long-time residents of any place, Pineys are suspicious of outsiders or "foreigners." Their suspicion has been heightened recently by three occurrences: 1. Books written in the 1950's and 1960's about the Pine Barrens portrayed Pineys as quaint storytellers and loners from a past era. Pineys resent this and suspect any author of similar intentions.
2. State-owned Wharton State Forest occupies about 70 percent of the township's total land; the State pays taxes of 10¢ an acre on this land, and any suggestion of the township's working with the State or providing input to a state plan raises residents' hackles.

3. Recent Pinelands legislation has not yet been explained to residents, many of whom are convinced the State is ready to take over most of the rest of the township.

To overcome this suspicion requires patience and time more than anything else. The author has been working with people in the Pine Barrens for the past 6 years, and some of his students live in the Pines. Without the friendship which has been built up over several years, this project would not have been possible. Even so, many residents remain suspicious and have refused to talk with the researchers. Under such conditions, no attempt was made to conduct a random sample survey but, instead, the researchers went to community leaders and residents who were willing to be inverviewed.

Another difficulty lay in the general social organization of Pineys. They rarely gather in large groups, so it is difficult to conduct group interviews; and the interviews we had were conducted at people's homes. While home interviews produce the most authentic responses from Pineys, they are lengthly. Church meetings on Sundays are one of the few gatherings which occur regularly, and Geraldine Ginder conducted the mental map workshop with women at that time. The workshop was divided into 5 steps: 1. Discussion of the current trend toward public participation in planning, its success and failures and the need for local participation; 2. A description of how residents' input would be involved in planning; 3. Directions for drawing a mental map; 4. Map drawing; 5. Written descriptions of what they had included in their maps.

The last problem was the general responses of many of the residents who, when given the photographs, responded, "Oh, I like it all", or began choosing several photographs and lumped the test in a pile which they liked equally or simply did not care to choose. More than half the residents reacted to the photographs in this manner which suggests, as do their comments, that their visual sense of their environment is tied intimately to their other senses, their nostalgic memories and their use of the landscapes for recreation or economic purposes. At first the authors tried to induce respondents to finish, or at times even start, the ranking process, with notable lack of success. We, therefore, accepted the respondents' statements at face value. Interpretation of the results of these interviews will be found in the following section.

Selection of Paragraphs

After eliciting the first four mental maps, we intended to use them as guides to photograph areas of high visual quality; but this proved impossible due to variations in the perceptions of the relative locations of areas. Therefore, we had three Pine Barrens residents take us to areas they considered of high visual value, and shot 2 rolls of black and white film and one roll of color film during those field trips. The color slides, while more interesting and (to the authors' way of thinking) more aesthetic, did not represent typical landscapes better than the black and white photos. The response we wished to elicit from residents was a general one to a type of landscape rather than a specific response to the beauty of the photograph or a particular place they knew. The author pretested the color and black and white photos on 6 residents, and concluded that black and white photos were more appropriate than color ones for this study.

Photographs were taken of other landscapes and forest types which were not included in the mental maps. The 200 photographs then were divided among five generally-recognized forest types. These were culled to two of each type according to age of the stand, and also included river areas, and cut and burned areas. These 35 photos, when shown to the residents, were found to be confusing, and respondents would not or could not rank them. The number of prints was cut to thirteen, which allowed for at least one of each forest type. Respondents who were unable to deal with 35 photos were willing, at least, to select the 4 or 5 of the remaining 13 as the most attractive landscapes.

Results of Visual Resource Assessment

Mental Maps

We can draw four conclusions from the 15 mental maps which Washington Township residents drew: 1. Men ranged farther than women; 2. Cedar swamps were mentioned on most maps; 3. An exotic white pine forest was on half the maps; 4. 90 percent of the maps described at least 5 different types.

Men's and women's mental maps suggested classic rural American sex differences; that is, men work away from home and women stay at home. Men's maps described areas of 20 square miles or more, while the women's maps concentrated on their houses and the village surroundings; and one woman's map described only her house and garden. Although several women mentioned scenic sites 20 to 30 miles from their village, they did not include these on their maps. Ninety percent of the maps did clearly delineate the edges of the villages by roads and the Mullica River.

Cedar Swamp
20 years old
High Visual Rating

Hardwood Swamp
15 years old
Low Visual Rating

Cultivated Field
Medium Visual Rating

Pine/Oak Woods
25 years old
Prescribed Burn
Medium Visual Rating

Eighty percent of the mental maps described one or more cedar swamps and/or the white pine forest which the CCC planted in Green Bank in the 1930's. It is significant that these two landscapes are not abundant in the Pine Barrens since cedar forest acreage is decreasing and white pines are exotic. Other forest types were mentioned, but respondents did not duplicate any other sites; apart from edges and cedar swamps, specific landscapes on the mental map were peculiar to that particular map; but almost all showed at least 5 different vegetation types, which strongly suggests a preference for diverse landscapes.

Photographs of Forest Landscapes

Only one discernible pattern emerged in residents' ranking of photographs for high visual quality: 80 percent of the residents rated cedar forests in their first five choices of photographs. The reasons for this high rating ranged from purely aesthetic to good timber, good food and cover for deer. No other photos were chosen among the first 5 by even 50 percent of the respondents, and all photos were chosen among the first 5 by at least 20 percent of the respondents.

Again we should stress that the general reaction to the photos was, "Oh, I like them all." The major conclusions which we can draw from the visual study are that Pine Barrens residents appreciate the diversity of landscapes in which they live rather than any single one. What Pineys see in a photograph of a Pine Barrens forest or field is not only beauty, but a sense of the totality of their environment.

This conclusion must be clear to the resource manager and land-use planner. We need to manage Pine Barrens landscapes for diversity.

Additional Results

By using a variety of techniques -- interviews, mental maps and photographs -- two additional conclusions become clear which otherwise might have remained hidden: First, 60 percent of the residents without prompting mentioned wildflowers as an important visual amenity. Most often mentioned were wetland flowers, particularly members of the orchid family; but references to upland flowers, such as gentian and arbutus, were frequent. Second, 50 percent of the residents mentioned the only white pine plantation in the township as an important visual asset. Response to this stand was clearly aesthetic since the area supports little wildlife, few people walk in it, and it is only about 2 acres; however, its denseness and dark green color contrast strikingly with other upland forest types.

FOREST MANAGEMENT TECHNIQUES

Space does not permit substantive discussion of this and the following section on techniques to manage Pine Barrens forests for visual preference and the problem of public involvement in forest management.[5] It must suffice to state in this article that we need to manage for four goals: diversity, cedar, wildflowers, and white-pine-type forests.

Forest managers have many techniques to achieve diversity, most of which already are published in the literature. These techniques, including cutting, burning, seeding, drumming, etc., have been researched carefully (Little 1950, 1968, 1973, Little et al. 1952, 1958a, 1958b, Pierson 1979, Vivian 1979).

Creating diverse forest types on uplands is not difficult, and foresters do not at this time expect problems achieving high visual quality, either in these areas or along roadsides, which can be cut or seeded to produce a profusion of wildflowers (Little 1968).

White pine stands are neither economically nor silviculturally feasible in the Pinelands. Silas Little, however, is developing a pitch X loblolly pine hybrid which would form stands visually similar to pitch pine and which may outgrow the best pitch pine or shortleaf pines by 10 to 25 feet at 50 years (Little 1979).

The major problem forest managers face in the Pine Barrens is restoration and creation of cedar stands of which (at most) 50,000 acres remain, or only 5 percent of the total forest area (Pierson 1979). Cedar can reproduce itself by seed, if the seedbud is cleared and deer are kept out of the area. These both are formidable problems, especially since 2,4,5-T was banned, because this herbicide is the only one available which effectively kills swamp maples (Little 1963). As for deer, the only effective method to exclude them from seedling cedar areas (their prime winter food) is to fence them out, an outrageously costly proposition.

Unfortunately, it will be very difficult to reproduce cedar swamps. Until suitable methods are developed to exclude swamp hardwoods and deer, this valuable landscape will continue to disappear.

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[5] This and the following section will be discussed in detail in a forthcoming article.

PUBLIC PARTICIPATION IN FOREST MANAGEMENT

The most difficult challenge in managing Pine Barrens forests will be public participation. The historic independence of Pineys and their small land holdings throughout the region mitigate against large-scale management either by government or large private corporations. Because there is so little topographical variation, furthermore, landscape diversity for visual quality must be managed on a small scale; the viewer, in other words rarely sees more than several hundred yards in any one direction, so variations must occur frequently if landscapes are to hold viewers' interest.

Two variables will account for the success of small-scale management in the future: the residents themselves, and a new regional management plan which will be ready in 1981. Many residents of the Pine Barrens have families whose roots go back one hundred or more years, families whose livelihood consisted of managing forests (Sinton 1979) Many of these same residents have at one time or another cut timber, fought fires, helped prescribe burning efforts, reforested areas and created or drained swamps. Forest Managers, therefore, already have a skilled and willing resident labor force who want to stay in the area and who enjoy the work.

Second is the new regional management plan. The plan and management policies, now in the throes of political processes, are due in 1981. However, visual quality in the Pine Barrens will result more from actual management decisions than policies and guidelines. The closer these decisions are made to the local level, the more viable will be the actual management. At this moment, the State is willing to invest considerable time and money in public participation, and the author is sanguine about the chances for success.

Given a reasonable administrative framework, one must also make small-scale forest management economically feasible. Economic-feasibility studies will be done to determine the costs and benefits of long-term forest productivity versus those of residential development. Included in this analysis will be the visual resources which residents have defined for themselves.

SUMMARY

1. While classic methods to measure visual quality are useful for some studies, they are of limited use when evoking responses from long-time rural residents. To separate these people's visual experience from their other senses can be dangerously misleading.

2. By using a combination of photographs, mental maps and, particularly interviews and informants, we can, nonetheless, derive an idea of how residents experience their landscapes and the diversity they require for a healthy and balanced environment.

3. These exercises can illuminate critical management problems such as, in this study, the difficulty of regenerating cedar forests. Also, we can learn ways to enhance otherwise-unnoticed landscapes, such as roadsides, for wildflowers.

4. Last, this study suggests that if public participation is incorporated at the beginning of a planning study, rather than tacked on as an afterthought, management by local residents will be feasible.

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Toward a State Landscape Policy: Incremental Planning and Management in Vermont[1]

Mark B. Lapping[2]

Abstract: The issue of landscape management and enhancement has been of deep concern to Vermonters for many decades. This concern, which has been institutionalized through specific policies, stems from the dual desire to maintain the unique attractiveness of rural Vermont and the need to preserve and enhance a landscape which is basic to a huge recreational and tourist industry. From a planning theory perspective, this has taken place over a period of years, through a discrete number of policy and managerial judgments and in a generally incremental fashion. Yet today, Vermont has created as comprehensive a landscape quality management policy as has any state in the nation.

INTRODUCTION

The terrain of planning theory is littered with the books, papers and plans of those who have consistently articulated the logic of comment. If the rhetoric of planning theories runs this way, certainly the style and performance does not. What appears more typical are disjointed and incremental approaches which one critic and theorist (Lindbloom 1959) has called "muddling through." The wise maker of policy, accordingly, "proceeds through a succession of incremental changes" and "avoids serious lasting mistakes. . . ."

Landscape has rarely been seen as a central concern for planners. Even in land use planning processes, the problems associated with landscape value and quality are either unaddressed or are more frequently sacrificed in some trade-off equation. Evidence tends to confirm this as the body of land use case law suggests that landscape and scenic parameters are only now becoming controlling elements in litigation. As Norman Williams (1975) notes in his major treatise on land use law "while the subject matter is one of the important emerging fields of planning law, this is a field where the case law is as yet relatively unimportant, because there has been so little of it."

THE VERMONT CONTEXT

The development of a landscape policy in Vermont has been typified by incremental and disjointed approaches. Indeed, it is so fragmented and uncoordinated that few Vermonters, including policy-makers and planners, would acknowledge that such a policy exists. In a slightly cynical vein, this may explain why the state's approach to landscape and scenic resources has been successful.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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The issue of landscape management and enhancement has been of consequence to Vermonters for several decades. This concern, which has been institutionalized through specific policies and programs, stems from the dual desire to maintain the rapidly disappearing attractiveness of rural Vermont and the need to preserve a resource base fundamental to the survival of a major recreational and tourist industry.

Vermont's policy is composed of a set of strategies which operate on two levels: a macro-scale, which transcends the entire state and a micro-scale, far more site-specific. The first category is composed of the following elements: the statewide bottle and can deposit law; limitations on mountaintop development through Act 250; a backroads restoration and preservation program, and highway sign prohibitions. The second grouping of policies consists of other factors: specific project review under Act 250; a natural areas system; farmland and open space contracts and other methods to preserve farmland; and local historical preservation programs.

STATEWIDE POLICIES

Numbers of specific policies and programs have been implemented which impact the landscape of the entire state. As such, their importance is obvious and is little affected by regional or local variations. As a grouping of policies, they represent some of the unique perceptions Vermonters have of their collective landscape.

Beverage Container Law

While it may seem odd to include such a policy in among landscape quality programs, few steps have been as significant in maintaining scenic value as has this piece of legislation. Vermont's first attempt at a "bottle bill" occurred in 1953 when the state legislature passed an act which prohibited the sale of "beer or ale in nonreturnable glass containers." Extended in 1955 for another two-year period, and found a constitutional exercise of the policy power in Anchor Hocking Glass v. F. Elliot Barber, 118 Vt. 206, 1954, the law nevertheless died in 1957 under heavy lobbying by the glass bottle industry. Vermont's second and present law took effect in 1973. Amended in 1975, the law became more effective in that it now banned detachable fliptops on beverage cans and all throw away glass bottles.

In terms of its landscape implications, the greatest impacts have been in terms of the reduction of highway litter. A Vermont Highway Department survey of "before" and "after" highway litter noted that during the 1973 annual summer highway clean-up, 25,403 bottles and cans were collected. One year later, after the law came into effect, only 6,082 bottles and cans were collected. This was a reduction of over 75 percent.[3/] At the same time the return rate was over 80 percent. Robert W. Fraser (Franchot 1978) of the state's highway department has observed that "the bottle law has greatly influenced the reduction of litter volume along Vermont roadsides, and it is noticeable. We receive considerable correspondence from tourists and transient motorists who express amazed pleasure at the cleanliness of our highways." The legislation has created jobs, saved fuel, spawned the recycling of other materials and contributed in a most fundamental way to the reduction of highway litter and the enhancement of the roadway landscape.

Mountaintop Development Limitations

The Green Mountains are the backbone of Vermont. Stretching the entire length of the state, the mountains are the essence of Vermont. Forested slopes are critical both to the forest resources and recreational industries. The protection of mountaintops above 2500 feet --deemed an important ecological dividing line --has been given special recognition in the state's omnibus land use law, Act 250. While development above the 2500 foot mark is not prohibited outright, a special permitting process is required and the Environmental Board--the quasi-judicial body which administers the program--must find that the development "will not have an undue adverse effect on the scenic or natural beauty of the area, aesthetics, historic sites or rare and irreplaceable natural areas."[4/] The burden of proving an "undue adverse effect on aesthetics" lies with those parties opposing the grant of a development permit. To date, the majority of applications for development have concerned the installation of communications facilities, though some logging operations and ski lifts have also been involved. A ruling dealing with the application of Karlen Communications, Inc. (Declaratory Ruling No. 89) suggests the difficulty in implementing and enforcing this

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[3/] "State of Vermont Special Highway Litter Evaluation Project," Vermont Department of Highways, Montpelier.

[4/] Criterion 8 (10 V.S.A. 6086 (a) (8)).

measure. Karlen sought to construct two microwave disc antennae on the top of the highest peak in Vermont, Mt. Mansfield. After an initial granting of a permit, an appeal was lodged by several parties, including the Town of Stowe, the site of the proposed development. Stowe's attorneys argued that any increase to the visual impact of existing man-made structures would be detrimental to the natural and scenic beauty of the mountain. The town further argued that its economic base was dependent upon scenic qualities and that further development would constitute a negative factor. The town did not, however, provide the studies necessary to substantiate its claims. That the construction would be visible from roads entering Stowe was not debated. The town maintained again that the impact of this would be adverse while Karlen argued that it would be minimal. The state's Agency of Environmental Conservation, which supported Stowe's position, argued that the concept of "undue adverse effect" was impossible to evaluate and that "individual applications represent piecemeal development" and that the cumulative effect of developments is not being considered. The case raised, in a most direct way, the point that landscape policy is a "threshold" issue which makes the evaluation of individual projects most difficult. The Environmental Board decided in favor of the Karlen application. What, then, can be said of this section of Act 250 relative to the preservation of mountain landscapes? First, some of the most odious developments have been discouraged by Criterion 8 of the law. Second, what development has taken place has come under close public scrutiny. A review of the records indicates that modification of development plans and designs has often occurred. Third, the cost of development has risen as a result of this process of project review, as developers have intentionally sought to minimize the impacts of their proposals.

Backroads Restoration and Preservation

Vermont's scenic highway law was passed in 1977. The bill established that it was "the policy of the State of Vermont to preserve through planning the scenic quality of its rural landscape, and enable municipalities to designate town scenic highways which may be improved in accordance with standards combining aesthetic and functional criteria."[5] The standards for road improvement were to be developed jointly by the Vermont Agency of Transportation and the Vermont Scenery Preservation Council--created in 1966--which had advisory and consulting powers vis-a-vis towns in the state.

Scenic roads may be designated by towns with concurrence of the Council. A scoresheet utilizing a quality rating and weighting factor is required before a road may be termed "scenic." Factors considered include: vegetation (forest patterns, field and forest patterns, significant tree stands, leaf tunnel effects, birch tree stands, wildflowers, etc.); landscape features (scenic terrain, focal points and vistas, gravel road surfaces, etc.); waters (lakes and ponds, marshes and wetlands, rivers, streams, and waterfalls); buildings and man-made structures (picturesque buildings, farmsteads, round or octagonal buildings, covered bridges, stone walls, historical sites, village edges). Likewise, some negative elements must be evaluated as well; i.e., lumbering scars, erosion, junkyards, strip development, protruding culverts, etc.

Once a road is listed on the state's scenic roads registry, towns and state agencies must maintain and reconstruct roads according to standards as established by the Department of Transportation. These standards prescribe that scenic roads will be "maintained as nearly as possible in the condition which existed at the time of designation" and that "permitted roadside maintenance shall be detailed at the time of designation." [6] In an effort to aid town highway supervisors in maintaining backroads designated as scenic, a study entitled The Vermont Backroad: A Guide for the Protection, Conservation, and Enhancement of Its Scenic Quality was published with specific programmatic recommendations and practices.

The scenic highway law does not require the designation of scenic roads and in the future more specific aesthetic criteria will be required if a court challenge is offered.[7] Yet, in a state where tourism--especially leaf-gazing during autumn--is a major economic factor, valuable landscape assets such as backroads may be retained through the adoption of similar programs.

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[5] Public Act No. 58, Journal of the House of the State of Vermont, Adjourned Session, 1976.

[6] Rule No. 118-3, "Standards and Rules for Designation, Maintenance and Reconstruction of Scenic Roads," Vermont Department of Transportation, 1977.

[7] See Sena v. Board of Zoning Appeals of the Incorporated Village of Hempstead, 45 N.Y. 2d 105 (1978) which makes this point clear.

Highway Sign Prohibitions

This aspect of Vermont's landscape policy may be the oldest. Largely through the efforts of one individual, Rep. Horace Brown, Vermont adopted an advertising sign law in 1939. Brown's Law restricted signs along roads and highways through a formula which mandated that there may be no more square feet on the face of a sign than there are feet between the sign and the road. Norman Williams has noted of this control that "no total prohibition is involved--merely a reasonable setback regulation. Yet, the statute has been very effective, at least against the normal-size large billboards." (Williams 1974-1976). The constitutionality of the law was affirmed in Kelbro v. Myrick, 113 Vt. 64, 30 A.2d 527(1943). The coming of the interstate system, however, proved the inadequacy of Vermont's existing statute. Under the leadership of Rep. Theodore Riehle, a new Vermont law on highway signs was passed in 1967.[8] Considerable support for this far-reaching program came from diverse groups, including the Vermont Hotel and Motel Association,which clearly understood the relationship between highway visual quality and tourism. Essentially, Riehle's bill removed all billboards from Vermont highways and replaced them with uniform, small directional signs located at nonscenic locations (which were paid at the state's expense) and strategically placed travel plazas furnishing local service information. In an evaluation of the strategy by Peat, Marwick, Mitchell and Co., it was determined that nearly 100 percent of the visitors to Vermont favored the new system, while local businessmen were evenly divided.[9] Again, Williams writes that "the most remarkable part of the recent Vermont experience is that there has been no direct legal challenge to the validity of what is (in the context of current American law) a rather drastic scheme to remove all existing billboards and in effect to socialize the billboard industry (Williams 1974-1976).

SITE SPECIFIC POLICIES

Project Review Under Act 250

While this is not the place for a protracted analysis of Act 250, suffice it to say that it is Vermont's attempt at a comprehensive land use coordination and planning system. The law comes very close to being a system of performance standards for land use allocation. Ten requirements or criteria must be met before a development proposal receives permission for construction. The ten criteria include such parameters as "will not result in undue water or air pollution," "will not place an unreasonable burden on the ability of the local government to provide municipality or governmental services" and, again, criterion No. 8, "will not have an undue adverse impact on scenic beauty, aesthetics, historic sites, rare and irreplaceable natural areas, endangered species, or necessary wildlife habitat."[10]

An example of how this latter criterion applied in project review is provided by a 1971 ruling on a permit application for a Mobil Oil Corporation service station in the Town of Richmond. The proposed development site was to be located on a 4.5 acre parcel of land zoned for commercial use, lying adjacent to the Richmond interchange on Interstate 89. Testimony taken on the matter confirmed that undue stress would be put upon the aesthetics and landscape of the area. A case in point was made by the Secretary of Vermont's Development agency when he argued that the project was not in the interests of the state:

> Vermont's appeal to out-of-state visitors is based upon our uniqueness in that we have taken great strides to protect our scenic beauty and environment and have not overcommercialized our roadways and our landscape as other states have done. Vermont has taken great strides to protect the scenic views from Interstate 89 and one of the most attractive areas of Vermont is the view of the river valley in Williston and Richmond which combines the mountain splendor with rich agricultural land and typical Vermont countryside.

On the basis of much evidence, the regional environmental commission denied a permit for development on five findings of fact:

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[8] Vt. Laws 1967, No. 333 N.S.A. Tit. 10, 321 et seq.

[9] "Measured Effectiveness and Public Acceptance of the Travel Information System in the Brattleboro, Vermont, Area" (1971).

[10] Title 10, VSA, Chapter 151.

(1) The view from Interstate 89 of the Winooski Valley, which includes the proposed development site, is a unique and irreplaceable area of scenic and natural beauty.

(2) The proposed development for which the applicant seeks a permit will have an adverse effect on the scenic and natural beauty of the area.

(3) The findings that the proposed development will have an adverse effect on the scenic and natural beauty of the area is based on uncontradicted evidence to that effect.

(4) The proposed development will have an undue adverse effect on the scenic and natural beauty of the area.

(5) The District Commission #3 finds that the gain of a gasoline service station at the expense of marring a unique area of great scenic and natural beauty is detrimental to the general welfare of the people of the state.

As happens in many of these cases, the applicant came back to the commission after several years and reapplied for a permit for development. This time, however, Mobil radically re-designed its project on a smaller scale, with landscaping in harmony with the site and a greatly reduced sign which does not have an "undue adverse effect" on the landscape as seen from the road."[11] A permit was granted and the station now exists.

In a more recent case, a projected 82-store shopping mall in semi-rural Williston was denied a permit, though not on criteria 8 findings. The Pyramid Mall would have been big enough to contain 10 football fields. It would also provide more commercial floor space than exists in the state's largest city, Burlington (pop. 39,000). While many of those opposed to the mall tried to argue against it on criterion 8 grounds, the district environmental board found that an undue adverse effect was not created:

(1) the scenic and natural beauty of the area was "already affected" by a power transmission line traversing the site, a large water tank located on an "adjacent hill," and various commercial activities on some of the adjoining properties";

(2) the proposed mall building would not exceed 35 feet in height;

(3) the proposed mall building would "follow the contours of the land and be of subdued colors";

(4) any signs erected "would not be lighted" when the mall was closed to public use;

(5) the landscaping plan submitted by the applicant included "berms and extensive planting" which "would screen most of the mall buildings and parking lots from the view of motorists on the adjoining highway," and thus "would reduce visibility" from Interstate 89; and

(6) the implementation of an alternative plan submitted regarding exterior lighting systems involving the erection of 108 poles, each not exceeding 30 feet in height, would not exert the "undue adverse effect on the aesthetics of the area" that the implementation of a preliminary plan submitted, involving the use of 55 poles ranging from 30 to 50 feet in height, would have exerted on aesthetics, due to the "greater visibility both day and night" of this latter system of lights.[12]

The project was turned down on the basis of other criteria. "What the commission said, in effect, after months of deliberation, was that the mall would place great burdens on Chittenden County's traffic network and municipal services, that it would violate the rural character of the area and might seriously damage the future of Burlington (Green 1978).

Natural Areas System

Vermont is not alone among the states which have inaugerated a program for unique natural areas. Enacted in 1978, Vermont's program[13] established a system for the identification and protection of areas which are characterized by unusual or significant flora, fauna, geological or similar features with scientific, educational or ecological value. In Vermont's context this has meant the registration of important bogs and marshes, tundra ecosystems on mountaintops, virgin northern hardwood stands, unique nesting areas, etc. The registration system for natural areas is maintained by the Vermont Agency of Environmental Conservation and any project which may directly or indirectly influence or impact upon a natural area is required to go through an impact assessment process. Moreover, the Act 250 permit process must also be followed since "rare and irreplaceable natural areas" receive a degree of protection under criterion No. 8. The importance of a natural areas system has been summed up thusly:

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[11] Mobil Oil Corporation File, Environmental Board, Montpelier.

[12] Pyramid Corporation File, Environmental Board, Montpelier.

> Natural areas are not necessarily scenic, historically significant, or valuable for recreation. Rather, they are principally ecological preserves whose unique qualities distinguish them from the general landscape. For example, there are less than a handful of virgin beech-maple stands in Vermont. This fact makes them special, even though they are dominated by two species of trees common to New England. In these stands, as nowhere else, ecologists can study the results of undisturbed natural processes. By comparing them with the man-altered environments found virtually everywhere else, scientists can estimate the accumulated impact of our way of life on the environment.[14]

In terms of a landscape policy, the need to preserve such areas lies in their distinctiveness, ecological and otherwise, from the overall landscape. Some 70 such areas have been identified in the state and about half of these are smaller than 50 acres in extent. The ownership of these areas is mixed: some are owned by the State of Vermont (i.e., arctic alpine plant communities on the summit of Camel's Hump); others are privately controlled (i.e., epaphically distinctive plant communities at the Sugar Hollow Fern Colony); and still others have been donated by the Nature Conservancy to the University of Vermont (i.e., Four Brothers Islands in Lake Champlain). The diversity in ownership is probably as important as the actual diversity of the sites themselves. In addition to protecting such areas, the State of Vermont can and does acquire new areas through its Division of Forests, Parks and Recreation.[15]

Farmland Retention

Vermont is, above all else, a working rural landscape. Though hill farms have been disappearing over the past several decades, the river valleys of the state still support an active agriculture. Yet, problems for Vermont farmers abound, and hence problems with the retention of farmlands also exist. Urbanization pressures, changing ownership patterns, the recreational pressures, the reduction in capital available to the farming community, the lack of effective marketing practices and other factors are all having an impact upon farmland retention. Vermont has yet to develop a comprehensive farmland preservation program (Lapping and Feldman 1979, Lapping 1978). At the present time, Act 250's criterion No. 9 offers limited help in that it seeks to preserve "prime agricultural soils" with the burden of proof upon the applicant for a development permit. A differential tax assessment program is in the process of being implemented and a local option tax stabilization program exists for agricultural and forest lands.[16] A capital gains tax on land sales also exists, the purpose of which is to take much of the profit out of speculative land sales. The effectiveness of this law has yet to be determined.[17] Currently, the State Planning Office is in the midst of public hearings for a state economic development plan which contains several useful policies in regard to agriculture. Yet, it appears that these methods alone will not be enough to halt the loss of Vermont's farmland effectively. This area is the weakest element in the maturation of Vermont's landscape policy. Until such time as comprehensive programs which address both the land and economic viability of agriculture questions are created, Vermont can anticipate losing more of its farms. In a region where the contrast between farm and forest is so striking and so fundamental to landscape and scenic quality, a landscape policy without a farmland retention strategy will not be effective.

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[13] Title 10 VSA, Chapter 157.

[14] Summary Report, Vermont Natural Areas Project (Phase II) (Montpelier: Vermont Natural Resources Council for the Vermont Agency of Environmental Conservation, 1978), p. 3.

[15] Title 10 VSA, §2010.

[16] Title 24 VSA, §2741 and Title 32 VSA, §3846. These laws differ only to the degree that the former requires an affirmative vote of the community at town meeting while the latter stabilization contract does not require such a vote and can be extended directly by town selectmen.

Historical Preservation Efforts

Vermont has been continuously settled for well over 200 years. As such, sites of historic and cultural relevance exist throughout the state. These may include homes, churches and other buildings; covered bridges, farms and other agricultural units; some stone walls and other elements. Vermont's man-made landscape is an invaluable resource. Once again, the primary element of policy is a state historic sites registry tied in to the national system. Also Act 250's criterion No. 8 seeks to protect historic sites from "undue adverse impact" of projects. Likewise, sites of archeological importance are being identified and under the A-95 review process and Act 250 may be protected. Through a local option law, sites of historical importance may be exempted from inclusion on the "Grand List" and hence have no local property tax applied to them. Large village areas as well as distinctive individual sites have become registered historical sites. While in a strictly formal sense, a policy does not exist linking man-made landscape elements with those of a generally more natural resources-oriented type, a certain degree of convergence does exist within the decision-making process to protect both types of elements.

Other Landscape Policy Elements

Vermont possesses other important laws and policies which must be included in any discussion on the state's landscape strategy. Phosphate bans and shoreland zoning both contribute to preserving the integrity of water resources. Currently a wetlands protection bill is before the legislature, though it appears doubtful that it will pass during thi session. Airports, power plants, highways an other facilities are also subject to review a evaluation. And stretches of rivers which ma be termed "scenic" are also being evaluated f possible protection.

CONCLUSION

These elements of a landscape policy hav evolved over several decades. If one is to speak of a "Vermont landscape policy," howeve one must be willing to see it for what it is: uncoordinated, disjointed, clearly incremental in nature, and hardly articulated. Yet, something very real exists and has been effective to a large degree. While this paper has dealt with legislation and public policy, final mention must be made of the "Vermont mystique" which is so well defined and captured by the state's official magazine, Vermont Life. This element in landscape policy cannot be discount for it is the ideological underpinning of all efforts at protecting and enhancing the state' landscape quality. Wallace Stegner(Hall, Holt Hard 1969) has put things properly when he wro

> Vermont is a little like the ocean waters along the continental shelf--hitherto safe, now threatened, but with a chance of salvation if it can organize itself to act ahead of, rather than behind, the boom.
>
> . . .[I]f Vermonters can rise above their historical conservatism, which means also above their traditional individualism that sometimes approaches mule-headedness, and also above their Yankee appreciation of an immediate profit, they may yet save this corner of the continent, green and lovely."[26]

I would submit that they have begun.

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[17] Title 32 VSA, Chapter 236.

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Appropriate Combinations of Technology for Solving Landscape Management Problems—

Session I: Utility Corridors; Siting of Power Plants

Northwest Montana/North Idaho Transmission Corridor Study: A Computer-Assisted Corridor Location and Impact Evaluation Assessment[1]

Timothy J. Murray, Daniel J. Bisenius and Jay G. Marcotte [2]

ABSTRACT

A computer-assisted method was used to locate and evaluate approximately 1,200 miles of alternative corridors within an 8,000 square mile study region. The method involved in-depth impact analyses for nine major location criteria or determinant models. Regional "experts" from the Rocky Mountain area participated with BPA in developing model structure. Software were used to process linear and topographic data and to "optimize" least impact routes. Impact maps and statistics were generated. Computer output was tempered with extensive field work to develop preferred transmission line locations. Despite encountering problem areas in this application, the method is considered an effective, systematic analytical tool for regional scale planning and location projects where extensive and diverse resource data must be processed.

INTRODUCTION

The Bonneville Power Administration (BPA) is the Federal Power Marketing agency for electric energy generated at the 29 dams in the Federal Columbia River Power System. The Pacific Northwest is linked by more than 12,300 circuit miles of high voltage transmission lines operated by the BPA. A major concern of BPA is the physical and visual impact of transmission lines; in recent years BPA has increased its efforts to select transmission routes considering environmental, visual, and socioeconomic impact.

Recently BPA has acquired and developed a computer-assisted resource analysis method for the location and evaluation of transmission corridors.[3] [4]

This tool was used in a major study from 1975-1978 to examine alternatives for integrating additional electrical generation from Libby Dam into the BPA electrical grid and reinforcing service in the north

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Landscape Architect, Environmental Planner, Geographer; Bonneville Power Administration, Portland, Oregon.

[3] The software system (PERMITS) was purchased by BPA from Landscapes Limited, Madison, Wisconsin. The system is an adaptation of the GRID program developed by the Harvard Graduate School of Design for use in land use and resource planning (Lewis 1975). Through agency and public workshops held by BPA and Landscapes Limited, the system has developed into one which has gained recognition throughout the country.

[4] The corridors in this analysis are approximately one mile wide.

Idaho/northwest Montana area. The study was undertaken in cooperation with Region One of the U.S. Forest Service. BPA was responsible for overall project coordination.

The study demonstrates an integrated approach to land management which encompasses the successive steps of organizing resource data, identifying alternative locations, analyzing potential impacts of high voltage transmission lines and finally supporting a route/plan selection. A work management plan was developed for the study which set forth major phases and specified objectives, responsibilites and a schedule for their completion. This paper discusses the project chronologically.

STUDY AREA DELINEATION

BPA system engineers identified potential origin and terminal points for integrating new power from Libby Dam and satisfying other power requirements in the study area. Four systems plans were identified. Upgrading the existing 115 mile 115 kV line between Albeni Falls and Libby, Montana and building a new line from Libby Reregulating Dam and Libby Substation are common to all four plans of service. Plan A requires a second 230 kV line between Libby and Noxon, Montana and a substation and associated facilities. Plan B requires a second 230-kV line from 120 to 140-miles long from Libby to Rathdrum Substation in Idaho. A 115 to 140-mile, 230 kV line would be built between Libby and Sacheen Substation in Washington under Plan C. Plan D provides for one 230 kV line between Libby and Noxon and another from Noxon to Rathdrum for a total of 115 to 145 miles. The above locations are shown on figure 4.

The next task was to define a study area that would include all feasible electrical plans of service. Criteria for study area delineation included political jurisdictions, recreation and wilderness areas, topography and data availability. The study area encompasses approximately 8000 square miles in eastern Washington, north Idaho and northwest Montana (fig. 1).

MODEL REVIEW AND ASSESSMENT

Nine models that predict impact from construction, maintenance or operation of a transmission facility form the analytical basis for the method. Workshops involving resource experts were conducted by BPA and Landscapes Limited in 1974 to organize the models, establish the data requirements and assign relative impact weights. A modified nominal group procedure developed by Andre L. Delbecq (Huber and Delbecq 1973) facilitated this process. The nine impact models are:

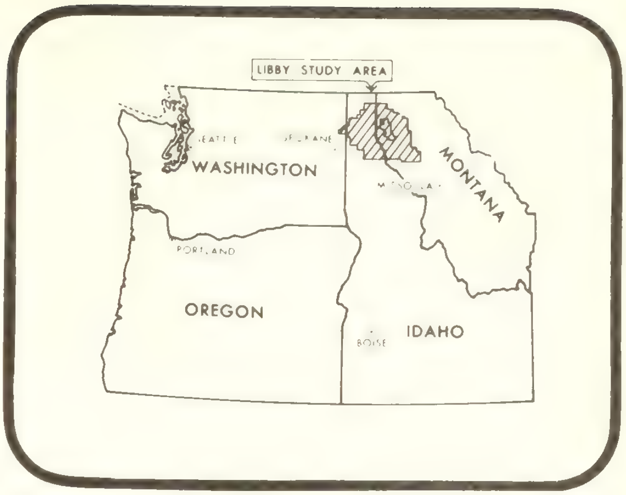

Figure 1--Study area location within BPA's four-state service area.

1. Urbanized Land Uses
2. Natural Systems
3. Potential Visual Impacts
4. Recreational Activities
5. Agricultural Land Use Practices
6. Forestry Land Uses
7. Extractive Land Uses
8. Potential Right-of-Way Sharing
9. Transmission Facility Problems

The models were assessed to ensure data practicality and availability and model logic and appropriateness. Two models --visual and forestry-- were insufficient. Consultants were hired to prepare more effective analysis models for visual and forest resources (Blair 1976, Moore 1976). Four determinant models (transmission facility problems, potential right-of-way sharing, recreation and natural systems) needed modification and adjustment. Workshops were conducted to refine these models. The products of this study phase were a final set of models and the data list.

DATA COLLECTION, INTERPRETATION AND DIGITIZATION

The analysis demanded a systematic approach to data collection, mapping, interpretation and storage. Data bank development involved collecting information and organizing it into a computer compatible format. Primary data sources included public and private published documents, ERTS imagery, low-level aerial photography and USGS topographic quadrangles. As part of the cooperative effort, the U.S. Forest Service provided considerable mapped resource information.

In most cases data were interpreted from the primary sources and mapped on 1:125,000 or 1:250,000 scale work maps. A grid of 8000 1-minute latitude by 1-minute longitude cells was established for data storage, retrieval and analysis. Average cell dimensions are 6080 ft. (1850 m) by 4160 ft. (1270 m), or 570 acres (230 ha). The grid was superimposed on data work maps and more than 150 data items were coded for each cell by percent of cell, presence/absence, frequency, or length depending on the data characteristics. General data categories included:

1. Climatological factors
2. Slope/aspect
3. Geologic hazards
4. Soil erosion susceptibility
5. Hydrologic factors
6. Wildlife habitat areas
7. Rare/endangered wildlife habitat
8. Vegetation cover
9. Special status areas
10. Agricultural land
11. Forest land
12. Developed recreational land
13. Dispersed recreational land
14. Other recreational land (designated natural areas)
15. Historic and cultural places
16. Existing land use
17. Planned land use
18. Zoned land use
19. Transportation features
20. Utilities
21. Visual quality
22. Landscape visibility
23. Land ownership

Most of the data was coded manually and keypunched. Data were checked using the Harvard GRID mapping program (Sinton 1973) and entered onto the data base. A digitizing software package was developed by BPA to facilitate the coding process and to process various data items for input to the models. Another routine was developed to convert digital terrain data from Defense Mapping Agency (DMA) tapes into BPA system compatible form for use, in conjunction with the U.S. Forest Service's VIEWIT program (Travis 1975), in the visual and engineering models. This software package has been a catalyst for further research and development. BPA's current tower-spotting program, for example, uses much of the same software.

Data accuracy and validity were tested. From field review of a one-percent sample of study cells, it was determined that data locations within the test cells were highly accurate.

DETERMINANT MODEL ANALYSIS

Analysis maps were generated for each model using programs which multiply the potential impact weight by the percent of cell data values to yield relative impact indexes. Normalized scores range from 0 (little impact potential) to 100 (high potential for impact).[5] The output is a set of impact files which were used to produce a variety of analytical and descriptive information. For each model, computer maps were generated that spatially describe potential impact (fig. 2).

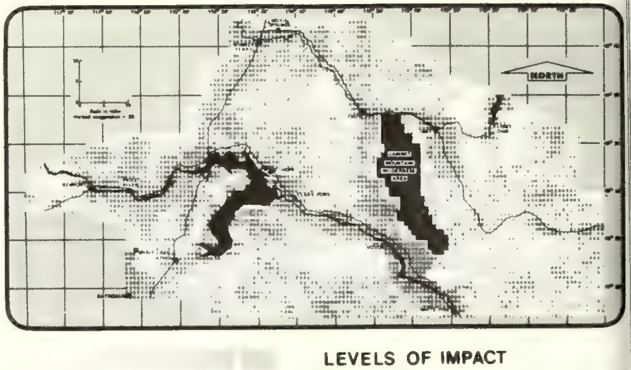

Figure 2--Visual impact potential, displayed in distinct shades of gray. Darker shades indicate greater impact.

Data maps were visually and statistically correlated with model maps to identify patterns and additive effects of data. Model validity was assessed by resource experts familiar with both model composition and study area characteristics. Model realism and logic were judged qualitatively. The models reasonably represented and measured the potential for impact across the study region. A thorough examination of the data maps, backed up by first-hand knowledge of the region itself, supported this conclusion.

CORRIDOR DELINEATION

This study phase involved synthesizing the model analysis results to derive alternative corridors for each of the four plans of service. The method incorporates an optimization program that computes and defines a "least impact" route between two points. Since the least impact value system connotes maximum impact on highly weighted data items, cells having high percentages of valued resources are theoretically avoided. For example, optimizing the recreation model should generate corridors which avoid roadless areas, developed recreation sites, and special status areas such as wild and scenic rivers.

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[5] Numeric scores are calculated for each grid cell in the study area and for each model and sub-model data grouping (Wisconsin Power and Light 1973).

A least impact corridor was computed for the land use, natural systems, visual, recreation, forestry and transmission facility problems models for each plan of service. The remaining determinants (agricultural land use, extractive land use and right-of-way sharing) were not optimized because those resources are concentrated in rather specific areas. Specific sets of evenly weighted determinants were optimized, including a combination of all determinants, to yield 12 basic sets (i.e., six individual determinants and six sets of unweighted combinations) for each of the four system plans (fig. 3).

Synthesizing the analyses proved to be a difficult undertaking. In theory policy/decision makers could work together, guided by a nominal group process, to establish "weights" that would accurately reflect the overall importance of each determinant. The resource weights could then be used to prepare a composite map that would guide the facility location process. Such a weighting procedure was not attempted as part of the study. It was not only difficult because of pronounced resource and value differences across the study area, but conceptually questionable to combine impact measures by relative weights.

The reasoning is that each analysis model at the determinant level predicts impact on a particular resource or set of resources. For example, a value is calculated that indicates the impact on forestry in a cell. A value for visual impact is also computed for the same cell. In short, discrete values are calculated for all resource concerns. To combine the values for each cell, numerically weighted to reflect the concern of a group of "decisionmakers," destroys the inherent value of the analysis for any of the nine major resource concerns (models). For the same cell, low impact on one resource would tend to moderate high impact on another. The resultant value in the cell then says little about what the overall impact is likely to be and seemed too elementary for use in determining corridors. It appears from observation that the decision process must recognize that different resource concerns are impacted differently but that meaningful synthesis requires that all values remain discrete during the allocation process.

A classical approach to land and site design was chosen for the corridor delineation process. This process is based on: data describing the study area; the predictive impact analyses; and, familiarity with the site gained during field reconnaissance. Model maps and optimized routes were carefully studied, by a manual overlay technique, to discern spatial differences and commonalities. Attention was given to determining which resources tended to force corridor deviation from the most direct path. Sensitivity indices (Wisconsin Power and Light 1973) for each optimized route were an integral part of the process. Whereas optimizations represent the "best possible" route between two points spatially, sensitivity indices do so statistically. Other optimized or field-generated routes can be statistically evaluated to determine

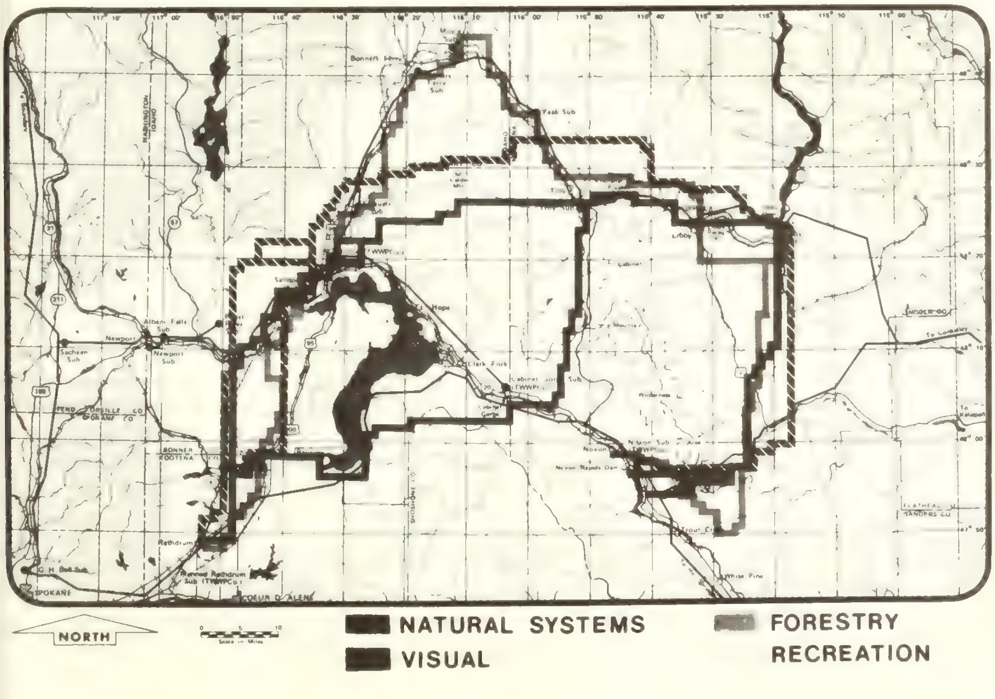

Figure 3--Optimized corridors from combining the natural systems, visual, recreation and forestry models.

deviation from this "best case" route. These comparisons were of significant value.

The study team spent time in the field, then synthesized the data, determinant analyses, optimizations, ground truth and study area knowledge. In essence, the synthesis involved manually overlaying analyses maps and by comparison, evaluation, and refinement ultimately defining all possible corridors. More than 1200 miles of alternative corridors were delineated (fig. 4). They constitute frames-of-reference for subsequent discussions of potential impact.

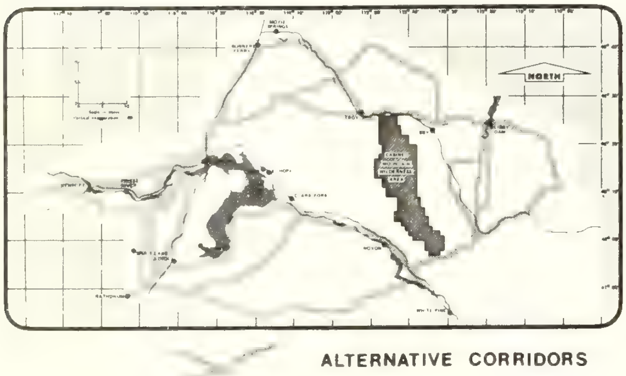

Figure 4--Alternative corridors are the feasible paths for integrating power between Libby Dam and various terminal points.

ENVIRONMENTAL IMPACT STATEMENT

The Draft Facility Planning Phase to BPA's annual Environmental Impact Statement (EIS) (USDI 1977) is the culmination of the study process. BPA specialists evaluated the analysis information for each plan of service. These evaluations form the basis of the EIS document.

The EIS is a summary of the potential impacts of the alternative corridors. Its objective was to present these results as accurately and efficiently as possible to facilitate the decisionmaking process. The document had to demonstrate that applicable legal requirements had been adequately addressed during the study. Legislation including the National Environmental Policy Act of 1969 (NEPA), the Endangered Species Act and other legal mandates specify such requirements as obtaining public involvement and conducting applicable endangered species consultation.

To produce a concise decisionmaking document, a summary approach to impact analysis was completed. An impact consensus, based on all impact analyses, was arrived at using modified nominal group procedures. A summary impact table was incorporated in the EIS.

To obtain an accurate account of public response during the EIS review process, a content-analysis procedure was adapted to quantify and categorize, systematically, the significant content of information.[6] The core meaning for each independent unit of written or voiced communication received was distinguished, summarized and categorized. All public meeting transcripts and all written public and agency correspondence were interpreted. Major response categories were:

Major Concerns	# of Comments	# of Respondents
Power Corridor Plans	27	31
Existing Corridors	19	19
Other Proposals in Area	27	18
RARE II and Wilderness Areas	13	10
System Reliability	13	7
Costs/Benefits	11	6
Project Need	5	5
Wildlife	12	2
Forest Products	6	5
EIS Preparation	19	9
Kootenai River Diversion	5	4
Conservation and Consumption	10	5
Herbicides	13	4
Miscellaneous	10	6
Other	36	11

A third effort of this study phase involved endangered species consultation. Possible adverse impact on the grizzly bear (Ursus arctos horribilus), a Federally threatened species, was predicted from the analysis.

BPA initated formal consultation with the U.S. Fish and Wildlife Service to determine possible consequences of the plan of service alternatives. The consultation also included the Northern Rocky Mountain Timber wolf (Canis lupus irremotus), listed as endangered. Consultation regarding the bald eagle (Haliacetus leucocephalus) was subsequently entered into and is to be concluded prior to issuance of the final EIS. BPA-sponsored eagle habitat studies are currently underway, and will serve as critical input to the final biological determination.

An electrical system plan was selected by BPA in June 1978. Plan B, the selected plan, combines upgrading existing facilities and constructing new lines on existing right-of-way to meet the long term electrical needs of the study area. Factors important in the decision included using existing right-of-way; developing a flexible, reliable, multi-purpose facility; conserving power transmission losses; and minimizing environmental impacts. Specific inputs to the decision included (1) engineering and economic studies, (2) the draft facility planning phase and (3) concerns expressed during review of the document. In that the latter two are direct products of this study, the impact analysis process discussed herein has had a important role in facilitating the making of a major land use decision.

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[6] Personal Communication, Eldon H. Baker, chairman, Department of Interpersonal Communication, University of Montana, Missoula, Montana.

FINAL PROJECT PHASES

Centerline route studies are scheduled to start during 1979. Site specific impacts will be identified and appropriate mitigating measures will be determined. Engineering surveys and construction work follow these activities. The transmission facilities are scheduled to be energized in the Fall of 1983.

CONCLUSIONS

This study is the first major application of a computer assisted location and evaluation process at BPA. The Environmental Planning Unit at BPA is currently undertaking a methods analysis study to evaluate this process as well as others. The methods study will recommend procedures for BPA to use for a wide range of location and evaluation projects. However, a few interim observations regarding the present study can be made.

An extensive array of data was required for the analysis. The benefits versus costs associated with the data base have yet to be assessed. What is certain, however, is that the task of limiting data collection to essential items was not entirely successful. A more thorough evaluation and restructuring of the models would rectify this.

The time required to build and maintain a data base is a function of its comprehensiveness. Data requirements often conflict with the realities of shorter-than-ideal study lead times and completion schedules. Although not a problem for this study, BPA (as do other agencies) usually faces strict project time constraints. There is no ready solution to this dilemma, although a combination of reduced data comprehensiveness, simpler models and/or smaller study areas can considerably reduce the data collection effort.

The process is designed for the location of new corridors. Therefore, the impact models do not adequately reflect the impact or problems associated with paralleling and/or rebuilding existing lines. However, with more than 12,000 circuit miles of existing transmission facilities, these are often practical options and reflect BPA policy. Models adequate to measure such impacts need to be developed, as BPA will continue to use existing facilities as appropriate.

Data cell size has been a critical issue. Cell size appropriateness is determined by many factors including data availability and scale, type of land use, study area size and computer capabilities. Many optimized corridors encountered environmental conditions not satisfactorily reflected by the one-minute grid cell. That the "best" routes were not initially generated was due primarily to too large a cell size.

The study area is characterized by steep topography and associated physiographic constrants. Field evaluation revealed places where optimized corridors encountered topography excessively steep to be technically feasible for construction. Provisions to reflect more adequately selected contraints, such as topography, exist but involve defining absolute constraints for appropriate categories of data. Such refinement would have helped initially define more satisfactory corridors.

Completing a "cycle" of optimizations based on additional model runs involved considerable time and several "cycles" were not possible. Thus, the many analytical tools and sub-programs of the system could have been used more extensively by converting to a 'real-time' mode whereby processing would be more-or-less instantaneous.

The level of data accuracy was reassuring; the data base was satisfactory; and the analysis models appeared to reflect potential impact systematically. These conclusions were corroborated by model review, consultation with resource experts and field review. The visual and forestry analyses--based on different techniques than the other models--became two of the better predictive models.

Despite its shortcomings, the study represents a successful effort by BPA to develop and apply a systematic resource analysis method to transmission location. It has been recognized by other agencies and groups as a positive contribution to land use assessment. Much of this recognition derives from the benefits of using an integrated approach. The approach has proved capable of organizing, storing and analyzing data reflective of landscape variations across a large study area. The comprehensive data inventory and analysis procedures are evidence of adequate study with regard to Federal legislation and other executive, state and local legal mandates. The study process also incorporated public participation, thus providing government agency and public input into BPA's planning process as required by sections 101 and 102 of NEPA. Additionally, the study has served as a catalyst for adapting computer programs, refining systematic data gathering techniques for use on other projects and enhancing relationships with other state and Federal agencies. Overall, through the use of computer technology it has been shown that a wide range of resource and cultural concerns can be systematically considered in locating corridors and assessing impacts.

Substantial information is required to make sound electrical transmission decisions at the plan of service, route and centerline levels. As one of the decision factors--along with engineering and economic data--resource information must be pertinent and accurate. It is fortunate that BPA management has made a commitment to the use of state-of-the-art procedures in location and evaluation studies. This study is significant and will be of special value for evaluating analysis procedures for wide scale use in BPA .

ACKNOWLEDGEMENTS

The authors wish to acknowledge the many people in BPA and the U.S. Forest Service without whose efforts this project could not have been undertaken.

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Aesthetic Impact of a Proposed Power Plant on an Historic Wilderness Landscape[1]

Carl H. Petrich[2]

Abstract: In this assessment of the aesthetic impact of a proposed nuclear power plant, the historic foundation of American concepts of scenic beauty played a major role. The plant is planned to be located on the Hudson River at the foot of the Catskill Mountains, an area that was also the geographical center of and inspiration for the country's nineteenth century romantic movement. The meaning and quality of several particularly outstanding views became the ultimate focus in studying the visual impact of the plant. A computer-assisted model of the surrounding scenic quality and a visual preference survey conducted among the local citizens completed the assessment. This research concluded that building the power plant in this location would entail an unacceptable, negative aesthetic impact. This finding was the basis for the issuance of a final environmental statement by the U. S. Nuclear Regulatory Commission recommending that the utility's application for a license to build this plant be denied, an action unprecedented in the history of the nuclear power industry.

ORIGINS OF THE VISUAL RESOURCE IN AMERICA[3,4]

In a symposium such as this on applied techniques for analysis and management of the visual resource, landscape architects all too often can find it easy to get caught up in the tools of our trade and lose focus on what we are truly measuring. The following case study illustrates a fitting example of a problem in visual assessment which joins the working techniques of the profession with the very meaning and origins of the American perception of what qualifies as "pretty."

The Proposed Greene County Nuclear Power Plant

As part of its federal licensing responsibilities under the National Environmental Policy Act of 1969 (NEPA), the U.S. Nuclear Regulatory Commission (NRC) performs independent environmental assessments of each application for a license to construct or operate a nuclear power plant. The NRC contracted with Oak

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Research Associate, Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830.

[3] Research sponsored by Division of Site Safety and Environmental Analysis, U.S. Nuclear Regulatory Commission under Interagency Agreement IA-544-75 with the U.S. Department of Energy under contract W-7405-eng-26 with the Union Carbide Corporation.

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Ridge National Laboratory to conduct an assessment of the projected environmental impacts of a $1.8 billion, 1200 megawatt nuclear power plant proposed by the Power Authority of the State of New York (PASNY) to be built in Greene County, New York, on the west banks of the Hudson River about 40 miles south of Albany. The proposed Greene County Nuclear Power Plant (GCNPP) is located at the base of the Catskill Mountains while the primary alternative site that PASNY proposed is to be 10 miles north (fig. 1). The engineering designs called for a 450-foot tall natural draft cooling tower and a 205-foot domed reactor containment structure. PASNY, a state-owned, tax exempt utility, would transmit the electrical power produced by the plant to the New York City metropolitan area where its principal customer would be the subway system.

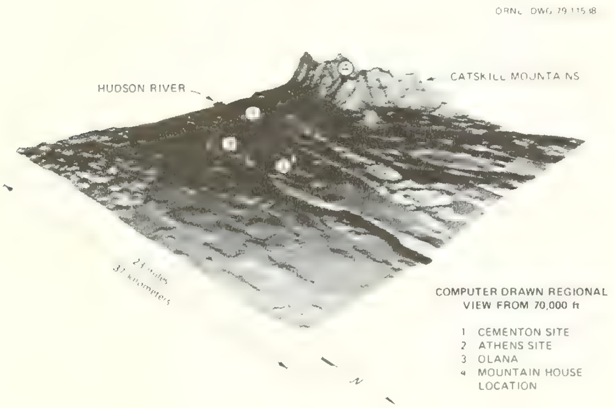

Figure 1--Computer-drawn view of the mid-Hudson River Valley and Catskill Mountains from northeast to the southwest. Topography and cooling towers have been exaggerated five times in the vertical dimension.

The Mid-Hudson Valley and the American Romantic Movement

In the first quarter of the nineteenth century the mid-Hudson Valley and the Catskill Mountains were considered the country's first wilderness. The American West and the southern Appalachians were quite inaccessible and largely unknown. When European visitors came to visit America, it was here that they were taken to see America's wild lands. Steamboats carried them up the Hudson River from New York City and then they proceeded by stagecoach or horseback into the mountains. In the second quarter of the nineteenth century the mid-Hudson Valley became the geographic center of the American romantic movement that launched the country's love affair with nature. It is in this respect that it is particularly signif cant to landscape architects and other evaluat of the visual resource. Romantic attitudes still abound in the collective concept of the American front yard, curvilinear subdivisions, large city parks, preservation of wilderness, etc. These concepts found their initial inspiration in the Catskill Mountains area during the middle of the nineteenth century.

The colonists viewed nature as somethin to fear and subdue. Jeffersonian America viewed nature as something to embrace and transform in order to cultivate a new agraria country gentleman life style. Romantic Ameri however, had to deal with a new force — the increasing industrialization that made the cities disagreeable but, on the other hand, seemed to make an agrarian idyll achievable for many. New technological advances such as the steamboat and the railroad (both reaching their earliest maturity in the commercial activity of the Hudson Valley) made the citie hinterlands accessible both for escape and fo exploitation. These two opposing aspects of technology were a chief source of the tension pervading the immediate antebellum decade and the source of the country's first indigenous fine art: the writings of Emerson, Thoreau, Whitman, Poe, Bryant, Dana, Melville and Hawthorne; the photography of Jackson; the designs of Downing and Olmsted; and the landscape paintings of the Hudson River School. This art gave America its first cultural identity to complement its emerging industria identity (based on the Erie Canal, the railro the telegraph, the steamboat, etc.).

James Fenimore Cooper's "Leatherstocking Tales" and Washington Irving's Tales of Sleep Hollow and Rip Van Winkle, this country's first reputable novels, were inspired by and permanently grounded in the Catskills' wilder setting. Thomas Cole recorded this landscape in a vivid, bold new style in his realist canvases which became the foundation of the Hudson River School. This groundwork enabled the great writers and luminist landscape painters to bring to fruition the romantic influence in America a quarter century later. New York City grew with the country and by th second quarter of the century became a busine community capable of providing the patronage needed to support artistic endeavors. By turning to its abundant wilderness, America, as a nation of art, had separated itself from European themes. Nature, in general, and the Hudson Valley and the Catskills, in particula were the new inspiration.

Portraying nature's glories and its revelation of divine plans for the country's immediate future consumed the artists' spirit during the entire romantic period. The cardi belief of the romanticists was that technology and the country's vast land resources would coalesce into a unique civilization, the climax of Western civilization, that would spread across the continent (Manifest Destiny). It was the mid-Hudson Valley that provided the combination of natural splendor and technological advance to inspire the leading figures of the romantic school. The people would live in a land not of the Jeffersonian country gentleman's dream, but of a middle area, a compromise between agrarian idyll and technological reality (Marx 1964). Few, if any, at the time truly foresaw what the dimensions of that technological reality might encompass only 10 to 20 years later (robber baron capitalism, mass production, urban blight, etc.). The tension between the agrarian dream and emerging industrialism spawned a romantic motif given image by the landscape painters. The image was one of an arcadian middle ground where man blissfully lived part in the city and part in the country (the still persistent suburban illusion). The public was looking for leaders to explain the new meaning of a nation dividing itself politically and of a paradise being invaded. The landscapists arose as the days' popular cultural leaders, giving the public what they wanted to hear and see — civilization was not merely stable, but was beginning to flower into a new Eden and all Americans were the new Adams (Huntington 1966). The American nation, as they popularized it, was on the threshold of a new Genesis. Because of this unique location, the aesthetic impact of the GCNPP must be viewed within this geographic and historic context.

ASSESSMENT TECHNIQUE

The aesthetic experience is dependent on an environmental stimulus, that which is seen, and the background and context of the observers, those doing the seeing. I employed three approaches, each centering on the landscape to be seen and on the context within which it is seen. This context encompassed the viewer's immediate geographical setting, expectations, attitudes about nuclear power and degree of affinity for and familiarity with the local landscape as well as a more detailed look at the historical and cultural context. The first two approaches, an analysis of the extant visual quality and an analysis, in part through use of a visual preference survey, of the potential viewers are heavily quantitative. The results of these two approaches (new and different applications of existing techniques) did not help to determine which of the chief sites was preferable. Therefore this account of the research will not dwell on these techniques used; the interested reader is advised to refer to the Final Environmental Statement (NRC 1979) which describes the details of these approaches. The analysis of the historic and cultural context of the plant did point out a preferable site in terms of the aesthetic impacts and will be described in more detail (but still briefly). This represented an unusual twist in aesthetic impact analysis and is also described, therefore, for the background it gives to all visual resource assessment.

Evaluation of the Extant Scenic Quality

This facet of the assessment considered the scenic quality of the area surrounding the two proposed sites. I evaluated the unique scenic features as well as visual "misfits" in the landscape proximate to the proposed sites. My colleagues at the Laboratory aided in developing a computer-assisted model of the scenic quality surrounding the two sites that helped assess the quality of the landscape in which potential viewers would stand. "Before and after" photographs assisted in simulating the visual changes likely to occur in views from critical viewing points surrounding the two sites.

Scenic Features and Misfits

Existing studies (Greene County Planning Department 1971; Jackson et al. 1977) were the basis for assessing the relative quantity and quality of scenic features (e.g., waterfalls, scenic overlooks) or visual misfits (ill-placed visually noxious industries, unscreened junk yards) within 10 miles of either plant site. The primary site, near the hamlet of Cementon, had considerably more scenic features than the chief alternate site, near the village of Athens. This is due principally to the closer presence of the escarpment of the Catskill Mountains (fig. 1).

Model of Scenic Quality and Visibility

I assessed the existing scenic quality of the possible viewer settings surrounding the two sites and analyzed the results in terms of whether or not a proposed plant would be visible from an observer setting having a given level of scenic quality. From this criterion, an appropriate plant location is one having low visibility or, if visibility is high, the scenic quality of those lands having visual access is low. The assumption is that the higher the scenic quality of a given location, the more sensitive a viewer in that area is to any intrusion in his visual field.

I used the criteria of landscape preference developed by Zube and his colleagues from their Connecticut River Valley research (Zube, 1973a, 1973b, 1974, 1976; Zube et al. 1974; 1975) to map scenic quality. Individual landscape variables (e.g. relative topographic relief, land-use diversity, land-use height contrast) were evaluated for subareas within a 5-mile radius around each site, weighted, and scores for each subarea summed. By summing the scores of each subarea within a given radius from each site, I could, in part, assess the relative scenic quality of each site. Alternatively, I multiplied a given subarea's score by the percent of land within it from which the cooling tower at either site could be seen. This assessed the relative scenic quality of that land having visual access to the cooling tower at each site.

Modeling Result

The results of the modeling effort were not definitive (from this perspective) in terms of suggesting which site may be the preferable location. Results showed slightly higher scenic quality surrounded the Cementon site. When lands with visual access alone were considered, however, the Athens site had higher scenic quality. Reliance on visibility impacts alone is of limited value in aesthetic analysis. Although people may reside in a specific locale, their transportation patterns mean they live (work, shop, attend school) at a regional level. With people traveling at this modern scale and pace, topography cannot conceal features in the landscape very long or very well. The results of a visibility analysis alone could, therefore, be misleading.

Figure 2*shows, by color, those areas having visual access to either site and/or both sites and, by shading pattern, the scenic quality of that land relative to the remainder of the land in the study area. This map reveals which areas are the most sensitive to construction of the GCNPP.

Simulation of Plant and Plume

To superimpose the plant on photographs of the present landscape a professional artist airbrushed in the plant and its visible plume (both appropriately scaled from calculations) on photographs from critical locations. A computer model (Dunn 1978) of a broad variety of visible plume alternatives provided the artist appropriate wind directions and dimensions for a "typical" (not a worst case, yet still visible) plume (visible plumes consist of water droplets and are dependent on hourly as well as daily and seasonal variations in a site's micrometeorology). The model's output also helped to characterize the frequency and extent of the visible plume throughout the year.

Figure 2--Study area defined by 5-mile radii around Cementon and Athens sites. Color indicates visibility to a cooling tower at either site, and shading pattern shows scenic quality of all land or water units. Darker shades indicate higher scenic quality.

With the help of the simulated plant and plume superimposed on photographs from critical viewing areas I described the projected aesthetic impacts based on traditional criteria of visual analysis (changes in line, texture, form, color, scale, etc.) and on the changes I felt likely to occur in the area's cultural and historical ambience.

Visual Preference Survey

The landscape is more than the aggregation of its component parts. Even an exhaustive set of relevant landscape variables could never totally explain all the variations in peoples' scenic preferences. I combined, therefore, a visual preference approach with the modeling and measurement techniques described above to assess the perceived whole.

A visual preference survey can assess, in part, how people feel about their environment and possible changes in it. People who live in the study area were surveyed because they are the prime group to be affected. In the survey, subjects expressed their preference by rating (on a numerical scale, 1 to 5) forty photographs of the local landscape; some photographs had cooling towers or cement plants superimposed on them. Cement plants were chosen as intrusions comparable to the power plant because they represent heavy industry, make sense in terms of the regional economic base, and represent a taxable industry. Additionally, respondents completed two pages of written questions to provide information on their attitudes regarding the proposed facility, nuclear power, their frequency of use of local recreational areas, their appreciation and use of the area's historic and cultural resources and their individual backgrounds. The technique was based in large part on the approach developed at the University of Michigan by Stephen and Rachel Kaplan and their collegues (Gallaher, 1977; Hammitt 1978; Kaplan, Kaplan, and Wendt 1972; Herzog, Kaplan, and Kaplan, 1976; Levin 1977).

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*See color illustration on page 394.

The professional artist assisted in the superimposition of cooling towers and cement plants on 16 of the 40 photographs. The result was eight groups of three photographers (such as the triad in figure 3) and sixteen other photographs. All photographs were middle-to-long distance shots of the local landscape. The photographs were reduced to 2 by 3 inches, randomized, and printed by offset process, eight photographs to the page. A total of 154 valid responses (from randomly approached respondents) comprised the survey. The survey had a very satisfactory distribution of respondents by age, sex, income, occupation, education, time lived in region, present residence and where respondents grew up. Twenty-four subgroups from the original sample were derived from the demographic information supplied by each respondent or from the nature of their answers to certain questions. Statistical cross-tabulations by subgroup pairs were made on all photographs.

The results of the survey were augmented by personal interviews with local residents and by a search of newspaper files for clues to attitudes toward the local environment. The conclusions reached here were that the people most likely to view the proposed GCNPP are likely to be strongly opposed to any type of power plant at either location, are likely to be strongly opposed to large natural draft cooling towers in their landscape, have apparently adjusted through familiarity or some other mechanisms to the presence of cement plants in their landscape, perceive their area of the Hudson Valley as having the highest scenic quality of any area between New York City and Albany, value and frequent the area's historic and cultural sites, strongly prefer the scenic quality perceived in natural or rural landscapes and, among other conclusions, perceive the proposed facility at Athens to be less of an aesthetic impact than it would be at Cementon. All in all, from the local resident's perspective, the GCNPP appeared to be highly unwelcome and inappropriate.

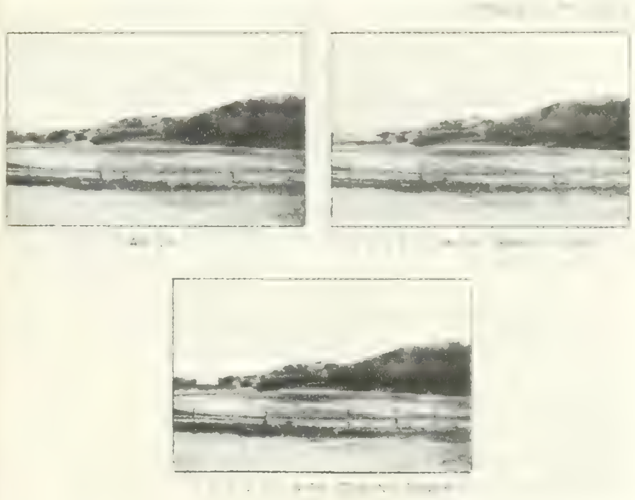

Figure 3--Typical triad of landscape photographs with superimposed industrial changes. Numbers indicate preference ratings respondents were to circle: 1 = not at all and 5 = liked very much.

Historic and Cultural Context

In exploring the historic and cultural context within which the proposed plant would exist, I used an analysis that continually narrowed its scale from the larger New England landscape and nineteenth century times down to the actual importance and present-day quality of the view from an historic site near the proposed GCNPP site. In each incremental focal step, the important point was the emphasis on uniqueness or special quality. In this respect, all the focal steps began to interrelate and a cumulative uniqueness and special quality emerged. A detailed account of this study is presented in a separate document (Petrich 1979).

As stated above, the mid-Hudson Valley in the mid-nineteenth century was the seat of cultural inspiration in this country. From the group of Hudson River School painters who were the leaders of the romantic movement one emerged as the most popular and best able to give graphic image to the public's longings and feelings about nature and America's role in Western civilization. Frederic Edwin Church put his considerable talents to use painting the icons of the time — archetypal New World images such as South American volcanoes, north woods' wilderness, North Atlantic icebergs, Niagara Falls, etc. Church grew up in Hartford, was a cousin of Frederick Law Olmsted and was Thomas Cole's only pupil. He learned landscape painting at Cole's home and studio (still existing) in Catskill, five miles from the proposed GCNPP.

After Church became a wealthy world figure (in his early 30's), he bought land atop a steep hill on the east side of the Hudson. There he applied his design genius for the next 30 years in constructing a mansion and grounds that exist today as one of the few surviving Victorian estates still in a setting comparable to its nineteenth century environs. Art and architectural historians have called it the most spectacularly sited mansion in the country and termed it the best site in the eastern United States (see references and discussion in Petrich 1979). Olana, as the estate is known, is about 6 miles from the Cementon site (fig. 1). The New York Times (1966) editorially referred to Olana as "the essence of the Hudson River School of painting...one of America's great cultural monuments...the authentic aesthetic expression of a unique moment in art and time." An article in the Saturday Review referred to the Olana site as a symbol, even the apotheosis, of all Hudson River landscapes (Kuh 1965). Theodore Stebbins (1978), the Curator of American Painting at Boston's Museum of Fine Art, said that Olana "is the best place to feel the spirit of the artist coming together with nature as it was in the nineteenth century."[5]

This is the importance of Olana to the present day and especially to those of us involved in assessing, protecting and enhancing visual quality. Our roots in landscape architecture come from Olmsted and the other romantic artists of his time. His roots were in the natural English gardens and in the landscape paintings of Turner, Constable, Lorraine and other European masters who inspired garden designers such as Brown and Repton. The goal of nineteenth century landscape design was to create three-dimensional picturesque views which looked like a two-dimensional painting. The American perception of that which is pretty can be traced directly to the prototypal landscapes such as Olana's and other estates' built along the Hudson Valley at this time and indirectly to their European antecedents.

The landscaped views at Olana were created by a master painter, a close relative of and undoubtedly much influenced by Olmsted. The mansion itself was designed by Church along with the collaboration of Calvert Vaux, Olmsted's partner in the design of New York's Central Park. The principal view (fig. 4) which Church celebrated at Olana was that to the southwest, a consciously developed motif of looking across the continent (Manifest Destiny again). This view has been universally acclaimed in both the art history world and in popular literature. It is a view of classic composition, one which Church painted at least 35 times. One painting (fig.5*) of this view has emerged today with the critical blessing of John Howat (1972), the Curator of American Painting and Sculpture at the Metropolitan Museum of Art: "[It] comes as close to perfection as anything done by American artists painting in the field."

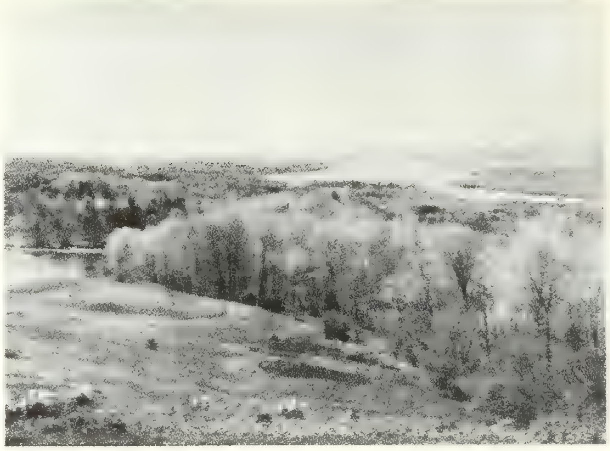

Figure 4--Southwesterly view from first floor of Olana, landscape painter Frederic Church's mansion on the east bank of the Hudson River. Church called this view "the Bend in the River" view.

Church did not merely find a beautiful site and build his house there. He found a beautiful site and created a three-dimensional painting with stone, wood, glass, trees, bushes and lawn. It is in the highest romantic tradition to create the views you wish to emphasize — to enhance the natural. Through places like Olana we can today try to understand the romantic nineteenth century world and the very roots of our aesthetic sensibilities.

The human preference is for controlled vistas — tamed nature (Kaplan and Kaplan 1978). We need wilderness for raw inspiration, but for our front yards, our local parks, for the daily refreshing of our spirits, we prefer the American landscape prototype: the nineteenth century Hudson River estate and its derivatives.

Figure 6 shows the location of the proposed GCNPP relative to Olana's celebrated view. The making of views is historically the essence of the landscape architect's craft. The GCNPP would severely inhibit the appreciation of one of the few remaining American landscape prototypes, original source material for understanding the beginnings of the landscape designer's profession and a living embodiment of popular American landscape taste. I foresee the GCNPP at Cementon to be an unacceptable physical and symbolic intrusion into a unique national treasure.

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[5] Verbal communication with Dr. Theodore E. Stebbins, Jr., Curator of American Painting at Boston's Museum of Fine Art, January 10, 1978.

*See color illustration on page 394.

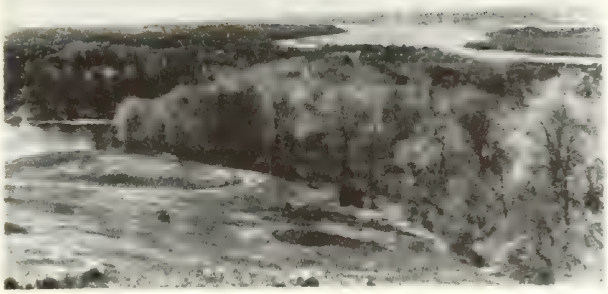

Figure 6--Church's southwesterly "Bend in the River" view (see fig. 4) with the GCNPP and its vapor plume superimposed at the Cementon location.

SUMMARY

The American visual resource has its roots in the romantic period. The glorification of wild nature in written word and in oil on canvas was the country's first universally accepted fine art. The notion of the sublime that originates from the romantic period lives on in our expansive wilderness areas and national parks and forests. The notion of the picturesque lives on in our parks, old estates and pastoral rural landscapes. The two are intimately connected in philosophical origin. Together they comprise our perception of high quality visual resources, our collective attitude about that which is beautiful. The Hudson River School painters were the first to point out these resources. Two-dimensional creations inspired Olmsted as much as they did Congress when it passed the legislation creating the Yellowstone National Park after viewing Jackson's photographic portfolio of its beauty and mystery. Thoreau himself personally recommended that Church visit the Maine woods to experience Katahdin country (Slavin 1974). The trip to Maine resulted in a painting in which Roderick Nash (1967) said "wilderness received triumphant portrayal." Nash wrote that this painting, *Twilight in the Wilderness* (1860), was instrumental in launching the wilderness movement in America.

Olana specifically and the mid-Hudson River area in general are the prototypal American landscape. As such in a highly industrialized region, they are endangered species. The NRC's Final Environmental Statement (1979) concluded that the GCNPP at Cementon would unacceptably diminish these national historic, cultural and scenic resources. This is the first impact statement issued by the NRC ever recommending the denial of a license to construct a nuclear power plant. That this recommendation is primarily for aesthetic reasons documents the progress in credibility and defendability visual analysis has made.

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Simulation of the Visual Effects of Power Plant Plumes[1]

Evelyn F. Treiman,[2] David B. Champion,[3] Mona J. Wecksung,[3]
Glenn H. Moore,[4] Andrew Ford,[3] and Michael D. Williams[5]

Abstract: The Los Alamos Scientific Laboratory has developed a computer-assisted technique that can predict the visibility effects of potential energy sources in advance of their construction. This technique has been employed in an economic and environmental analysis comparing a single 3000 MW coal-fired power plant with six 500 MW coal-fired power plants located at hypothetical sites in southeastern Utah. As part of this analysis, area residents were asked to express their preferences for computer generated scenes depicting visibility degradation as well as indicate the importance of visibility vis-a-vis the other impacts examined.

INTRODUCTION

As the U.S. strives for energy self-sufficiency, the use of coal as an energy source is becoming more widespread. Coal has always been viewed as a dirty energy source compared to oil or natural gas. Even with sophisticated pollution control devices, the airborne emissions from coal-fired power plants are greater than those from oil or natural gas. If we must use more coal, how can we mitigate some of the air quality impacts associated with burning coal? Our ability to mitigate these impacts will depend in part upon our ability to predict the impacts when new power plants are proposed.

The air quality effect addressed herein is visibility degradation in the form of plume blight. The paper describes a technique developed at the Los Alamos Scientific Laboratory to simulate the visual impact of a power plant plume in an observer's field of view and the use of that technique in a comparison of large and small coal-fired power plants in the West. Using hypothetical power plants in southeastern Utah, photographs were created to depict the plume blight from locations in Capitol Reef and Canyonlands National Parks from a single 3000 MW power plant and, alternatively, from six 500 MW power plants dispersed throughout the area. The discussion concludes by describing the method used to evaluate visibility impacts through the use of photographs to discern the values and preferences of southeastern Utah residents.

With the passage of the 1977 amendments to the Clean Air Act, visibility has become more than an aesthetic issue. The amendments are "to preserve, protect, and enhance the air quality"[6] in all existing national parks over 6000 acres, national memorial parks over 5000 acres, national wilderness areas over 5000 acres, and all international parks. These areas are designated by the act as "mandatory Class I," a classification which allows virtually no degradation in air quality. This classification will undoubtedly have significant impacts on the siting of future power plants in the Southwest--an area rich in national parks.

SETTING

The national parks of southern Utah are well known for their unique scenic features. It is a land of arid mesas and canyons, lush river bottoms, forested mountains, and boundless vistas. In this land of little moisture, what rain has fallen has helped erode the layered rocks into unusual formations, grace-

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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[6] Clean Air Act, Sec. 160(2).

There is more than sculptured sandstone in southeastern Utah, there is coal, both in the headwaters of the Price and San Rafael Rivers and to the southwest of Capitol Reef National Park in the Kaiparowits Plateau. Two coal-fired power plants, Huntington Canyon (800 MW) and Emery (1600 MW), already exist in the area and others have been proposed. Based upon numerous power plant siting studies made for this area, six potential sites were identified and two alternative electrical generation plans were developed. One siting plan would involve a single 3000 MW plant (four 75 MW generating units) located near the town of Green River. The other would involve two 250 MW units at each of six sites. These two sitings plans and the nearby national parks they could affect are illustrated in figure 1.

The national parks most likely to be affected by either power plant scenario are Arches, Canyonlands, and Capitol Reef. The dominant formations of these areas are multihued sandstones, which have been weathered into a myriad of forms. Arches' main attraction are its graceful red stone arches. Canyonlands contains sinuous canyons, stone arches, and towering spires, while Capitol Reef is a gold and white land of steep-walled gorges and rolling domes. The clear air, expansive vistas, and feeling of wide-open spaces have always been major attractions of the national parks of the area. Without this unpolluted air, an important part of the experience these parks provide would be lost. The potential loss of this resource to air pollution from coal-fired power plants in the region was important to the inclusion of the visibility and non-degradation provisions in the 1977 Clean Air Act Amendments.

Two sites were selected for simulating visibility impacts. The first is a view to the east from a point within Capitol Reef National Park. The other is a vista to the northwest from Island in the Sky in Canyonlands National Park. Only the view from Capitol Reef will be discussed with regard to the simulation of coal-fired power plant plumes. The simulations for Canyonlands can be found in Ford and Flaim, eds. (1979).

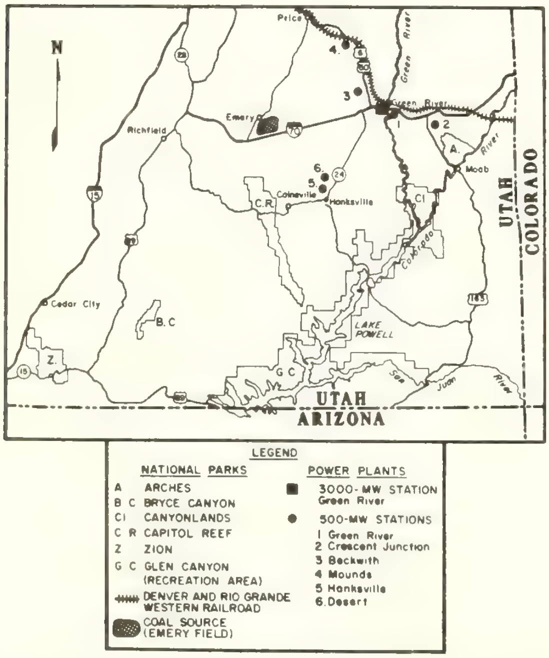

Figure 1--Location of hypothetical plant sites in southeastern Utah.

VISIBILITY SIMULATIONS

There are two situations in which visibility effects may be important. One occurs when the plumes from one or more power plants become dispersed in the atmosphere and cannot be readily identified with their sources. The result is regional haze and normally occurs during plume travel times from the plant which range from a few hours to days. In this case, the effects in a region are primarily determined by the total emissions that occur upwind and by the effectiveness of the removal processes active during the plume travel from the source to the affected region.

The other situation occurs when the plumes from one or more plants are visually obvious and can be identified with their sources. This usually occurs at points within a few hours of plume travel time from the source. This is called plume blight and may be simulated through a technique that produces a photograph of a scene with the smoke plume from a hypothetical power plant.

The simulation of plume blight begins with an actual color slide that is digitized as film densities to provide a background against which the plume calculations are performed. A modification, of this scene will result in a new image that incorporates either a plume, a general haze condition, or both. Next, a computer simulation of the brightness of three representative wavelengths (blue, green and red) in the background atmosphere is performed. A solution to the radiative transfer equation is found for a series of infinite planes oriented normal to the line of sight. Next, to perform this modification concentrations of atmospheric materials that scatter or absorb light are calculated along each line of sight using Gaussian plume dispersion relations. Calculated light scattering and transmission values for each line of sight are interpolated over the entire picture. The digitized film densities of the original scene are modified to include light transmitted through atmospheric materials and light scattered by atmospheric materials towards the observer. The revised densities in the simulated scene are converted to equivalent brightnesses and are displayed on a TV screen, which is subsequently photographed. A more detailed description of this technique and the calculations involved may be found in Williams et al. (1978).

Power Plant Characteristics

A number of source characteristics influence the visibility impact produced by a power plant: the emission rates of oxides of nitrogen, sulfur oxides, and fly ash, the stack height, the stack radius, the stack gas velocity and the stack gas temperature. Nitrogen oxide emissions are important because the colorless gas nitric oxide (the form in which the bulk of the nitrogen oxide emissions occurs is converted in the atmosphere to nitrogen dioxide--a red brown gas. Nitrogen dioxide may itself be converted to particulate nitrate, which scatters lightly Sulfur dioxide is a colorless gas that converts to light scattering particulate sulfates. Fly ash is also a light scatterer. The stack parameters--height, radius, gas velocity, and gas temperature--determine the height at which the pollution will drift with the wind.

Both large and small power plants in this study are assumed to achieve 90 percent control of SO_2 and 99.5 percent control of fly ash while burning low sulfur, low ash coal. The emissions assumed for the large plant are those projected for a 3000 MW facility actually proposed for the region (the Intermountain Power Project). The emission rates for each small plant were calculated by multiplying the large plant emission rates by the ratio of the plant capacities and the ratio of the plant heat rates (heat rate refers to the number of Btu's of coal which must be burned to produce 1 KWH of electricity). The heat rate of the small plants is 15 percent higher than that of the large plant. The assumed emission rates along with the stack parameters are listed below:

Source Characteristic	Small Plant	Large Plant
NO_x emission rate	506 g/s	2640 g/s
SO_2 emission rate	71 g/s	368 g/s
Fly ash emission rate	10.2 g/s	53 g/s
Stack height	152 m	183 m
Stack radius	2.64 m	6.47 m
Stack gas velocity	16 m/s	16 m/s
Stack gas temperature	355 °K	355 °K

Meteorological Conditions

The principal meteorological parameters that influence the visual impact of pollutants from a source at a specific site are the atmospheric stability, the wind speed and the wind direction. The atmospheric stability determines the rate at which material disperses in the atmosphere. With stable conditions, air temperature increases or slightly decreases with height. As a result, vertical plume spread is inhibited. Under these circumstances the plume is relatively obvious because it appears as a small band of dirty air extending across the clean sky. During unstable conditions the smoke spreads rapidly in both the vertical and the horizontal. Neutral conditions are intermediate between stable and unstable.

Low wind speed and stable conditions present the most obvious plume to an observer downwind of a power plant. Based upon temperature distributions measured at 1000 to 1300 feet (305 to 396 meters) above the ground (the expected plume height of a large plant during stable conditions) in an area east of Capitol Reef National Park, two-thirds of the mornings exhibited stable conditions (IPP 1977). Measurements of wind speed near Lake Powell at 1000 feet (305 meters) above the ground during the morning hours found that one-half of the wind speeds were under 2.5 m/s (Dames & Moore 1972). Based upon these studies, slightly stable conditions with wind speeds of 2 m/s are assumed to be adverse conditions for this analysis.

Wind directions were chosen that would bring the plume centerline from the sources to within 10-30 kilometers of the observer in Capitol Reef National Park. This would be a relatively adverse situation. The effects would probably be greater if the plume traveled directly toward the observer, but this would be a less frequent situation. Thus, the meteorological conditions assumed in the analysis do not present the worst situation, but an adverse condition that could be expected to occur occasionally. Sufficient data for the region are not available for a precise evaluation of the frequency of assumed conditions, but data from the Lake Powell area (Dames & Moore 1972) may be used to estimate their frequency.

At the Capitol Reef site, approximately comparable effects to those modeled from the large plant would be expected on about 5 percent of the mornings. Higher wind speeds of 4-6 m/s would give effects somewhat greater than those in the small plant case and would occur about 4 percent of the time. Thus, we would expect effects of magnitude comparable to, or greater than, those in the small plant case to occur on about 9 percent of the mornings. The two small plants near Hanksville would be expected to have similar effects on about 9 percent of the mornings also.

The neutral condition was chosen primarily to illustrate the role of atmospheric stability. A wind speed of 5 m/s is typical for this condition.

Description of Photographs

From a knoll on the east-facing slope of Waterpocket Fold in Capitol Reef National Park, the views to the north, east and south are magnificent. To the north and south, the buttes and mesas are visible for more than 30 kilometers. The view to the east, past Thompson Mesa toward the Henry Mountains, was selected as the background for modeling the power plant plumes (fig. 2*).

From this location, plumes from both the large plant at Green River and the two small plants near Hanksville (Desert and Hanksville sites) would be visible when the wind is from a northeasterly direction. Plumes from both the large plant and the small plants are modeled with meteorological conditions that would be expected during the morning hours before the air and the ground have been warmed and mixing of the air layers has occurred. Figure 3* shows the plume expected from the single large plant under these stable conditions, while figure 4* shows the plumes from the small plants. The color of the plumes is caused by a predominance of NO_x particles. The appearance of the plume will also be affected by the position of the sun relative to the plume and the observer. If the sun is behind the observer, the plume will appear darker than if the sun were in front of the observer because less light is scattered back towards the observer. The same position of the sun, mid-morning during February, has been assumed in the simulations.

Figure 5* shows the 3000 MW plant with a neutral atmosphere. Hence, the pollutants are more dispersed and less visible as a result of increases in wind speed and in mixing of the air. For the small plants under neutral conditions, the plumes are so dispersed that they are not discernible and figure 2 suffices as an adequate representation.

PREFERENCES OF AREA RESIDENTS

Visibility effects were among twenty-six different environmental, economic and social impacts of coal-fired power plants examined in a workshop held in southeastern Utah during the summer of 1978. The eight area residents selected for the workshop provided a sounding of local concerns, such as ranching and farming. Using Multi-Attribute Utility Measurement (MAUM), workshop participants were asked to express quantitatively the relative importance of the twenty-six different types of impact as well as their preferences of different magnitudes of the same impact. MAUM is one of a family of multi-attribute evaluation procedures (Raffia 1969, Keeney 1972, Gardiner and Edwards 1975). The relatively simple version used here was chosen because previous applications had indicated its ease of use with busy public officials (Gardiner and Edwards 1975, Gardiner and Ford 1976). Moreover, decision analysts have argued that more sophisticated and time-consuming procedures do not necessarily produce significantly better results than the simple procedures used here (von Winterfeldt 1975).

The photographs shown in the workshop were generated for an earlier small plant siting plan consisting of three 1000 MW plants rather than the six 500 MW plants shown in figure 1. Although the photographs used in the workshop were not the photographs shown in figures 2-5*, the workshop illustrates one manner in which simulated photographs of plume blight have been used in comparing large and small power plants.

Four photographs depicting a view from within Canyonlands National Park were presented to workshop participants for evaluation. These photographs showed "clean" conditions (no plumes or haze), the plume from a single 3000-MW plant under stable conditions, the plumes from three 1000-MW plants (one out of view behind the observer), and a general haze condition. Participants were each asked to indicate their relative preferences for the four photographs by placing them along a rating scale ranging from 0 to 100 where 0 is the least preferred and 100 the most preferred. Participants' responses are illustrated in figure 6. All participants placed the four photographs in the same rank order, preferring the 3000-MW plant's effects to those of the two 1000-MW plants and both to the hazy conditions. Six participants indicated that both power plant scenarios were much less preferable than clear conditions; two participants gave the opposite response saying the two power plant scenarios were only somewhat less preferable than the clear photograph but much more preferable than the hazy condition.

Participants were also asked to indicate the importance of visibility impacts in general relative to the other twenty-five types of impacts included in the survey. Participants were instructed to place the twenty-six types of impacts in rank order of importance, and then through pair-wise comparisons attach

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*See color illustration on page 395.

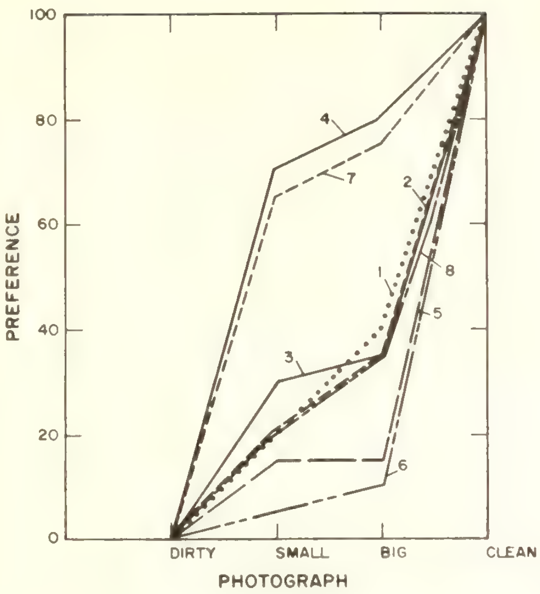

Figure 6--Response curves of six workshop participants.

numerical weights to each impact reflecting the ratio of its importance to the other impacts. These weights were later normalized to a common 0 to 100 scale by expressing each as a percentage of the total weight assigned to all twenty-six impacts by an individual. The average importance assigned to visibility was 3.3, while the median for all twenty-six attributes was 3.7. The range of importance attached to visibility was from 0.28 to 7.8. Overall, visibility ranked 16th in importance behind most of the boom town impacts (e.g., shortage of public facilities, fraction of housing in mobile homes) and air pollution related health impacts, but ahead of agricultural impacts resulting from transfers of water use (e.g., loss in production) and the visual impact of the power plant buildings and transmission lines. A more detailed description of the MAUM Workshop and the large versus small power plant project can be found in Ford and Flaim, eds. (1979).

SUMMARY

A technique has been developed for simulating the visual effects of smoke plumes on a scenic vista. The technique involves digitizing the information on a color slide and modifying the digitized film densities to correspond to the light scattering and absorption by the plume as indicated by the solution to the radiative transfer equation. The modified densities are displayed on a color TV console and photographed to provide a picture of the simulated scene.

This technique has been applied to compare the plume blight resulting from hypothetical large and small coal-fired power plants in southeastern Utah. Residents of the area were queried as to their preferences for the photographs generated.

With visibility protection in most national parks and wilderness areas now a national goal under the Clean Air Act Amendments of 1977, this methodology could become especially useful in evaluating proposals for new coal-fired power plants near these areas.

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Evolution of a Visual Impact Model to Evaluate Nuclear Plant Siting and Design Option[1]

Brian A. Gray, John Ady and Grant R. Jones[2]

Abstract: The development of a visual impact methodology is reviewed from first concepts (1973) to application.[3] The method can be used to train evaluators to use explicit criteria (vividness, intactness and unity) to assess change in a setting's visual quality as the result of construction of a nuclear facility, or any other visible alteration. Slides of "before" and "after" eye-level color photographs provide the basis for evaluating these criteria. The model converts these scores into a numerical index of visual impact.

INTRODUCTION

In 1973 the U.S. Atomic Energy Commission funded a study to evaluate environmental, social and economic options for the analysis of nuclear plant siting possibilities (Burnham 1974; Jones, April 1975). Consulting with Battelle Pacific Northwest Laboratories for the AEC, the authors developed a method to measure that elusive variable, "aesthetics." Experimenting with approaches developed earlier by many researchers (Jones, Litton, Leopold, Craik, Zube, et al.) a method was devised by which a small group of individuals using specific criteria can be trained to assess the visual quality of a landscape on an absolute numerical scale of 1-100.

This method has become an established technique for measurement of visual quality. Three main criteria were identified which may be combined into a simple equation to yield an overall, quantified evaluation of landscape visual quality: (1) vividness - a landscape's memorability, (2) intactness - the wholeness or integrity of its order, and (3) unity - the visual harmony of its parts. Use of these criteria diminishes personal bias and helps define the qualitative strengths and weaknesses of a scene. This approach can be applied in a wide range of projects and regional landscape settings, both wild and urban in character.

In 1975 the U.S. Nuclear Regulatory Commission asked the authors to apply the AEC method to determine the visual impacts of various cooling tower options for the Indian Point Nuclear Generating Plant at Peekskill, New York (Jones, November 1975). Ten viewpoints were selected from within the potential viewing area of the plant; each viewpoint was chosen on the basis of viewing distance, observer position and viewing population. Color photographs taken of the existing site from each viewpoint were air-brushed to simulate each proposed cooling tower option, including the vapor plume under "normal" atmospheric conditions.

Slides of fifty such photographs were evaluated at a day-long workshop by a group of architects, landscape architects, environmental planners and urban psychologists, after a two-hour training session in the use of the criteria. The visual quality of the six illustrated cooling tower options was compared to the existing quality for each view, to determine the degree of change from "before" to "after" for each option. This was multiplied by the number of viewer contacts at each viewpoint for an index of relative visual impact.

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[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Associates and Partner, Jones & Jones, Seattle, Washington.

[3] For a detailed presentation of this model, see Burnham (1974) or Jones (April 1975); for its application at Indian Point, see Jones (November 1975).

FORMULATING A CONCEPTUAL MODEL

At first considered to be both intangible and unmeasurable, aesthetics was among eight criteria identified by Battelle Pacific Northwest Laboratories (BNWL) in the analysis of nuclear plant siting options for the AEC. BNWL's multi-disciplinary impact evaluation procedure required a visual impact model which would (a) permit the evaluation of a range of potential facility types, (b) require relatively few evaluators for effective use, and (c) apply to any landscape/facility combination.

The conceptual model required a workable definition of "visual impact." Eventually "visual impact" was defined as "the change in visual quality over time resulting from the introduction of a facility into a landscape setting, as viewed from the surrounding area." To meet the requirements of that definition, we had to develop a reliable procedure to measure "visual quality," one that could be applied to a wide variety of settings. Merely to determine the degree of visual compatibility between the form, line, color, or texture of the facility and its setting was not sufficient for a model required to measure visual impact. An overall scale of visual quality was necessary to serve as a framework, within which actual degree of change could be measured.

An accurate and inexpensive method was required to simulate the appearance of the landscape before and after the introduction of a nuclear facility. To locate critical viewpoints from which a facility would be visible, a method to construct a visibility map ("viewshed") of the proposed facility was needed. Guidelines were then necessary to select representative viewpoints from which to simulate and evaluate alternatives. These individual evaluations at each viewpoint could then be interpolated for the entire viewshed.

The methodology had to be documented as a "how-to" guide in handbook format, with samples of criteria and scoring methods. Both BNWL and the AEC wanted the model to be used to train a team of evaluators to use the method, as well as provide a means to replicate the ratings and recommendations of everyone from the so-called "experts" to the general public. But budget limitations did not permit sophisticated public testing or extensive research.

Comparing the impacts of various facility designs at different sites was another problem, as was deciding on the significance to be given to the number of viewer contacts in relation to the amount of change in visual quality. How could the visual impacts of a nuclear plant with natural-draft cooling towers in a high-quality forested valley setting with a small viewing population be compared to a plant using large cooling ponds in a medium-quality industrialized urban landscape with a large viewing population? Was there any way to measure the extent of change in visual quality in a way that would acknowledge that landscapes of high visual quality are becoming rarer and hence are more valuable than those of low visual quality? Was it possible to compare very different landscapes on one scale of quality?

These considerations led to the following hypotheses, from which the model developed:

(1) A landscape's visual quality can be measured in an unbiased way by trained individuals using explicit criteria.

(2) A change in landscape visual quality can be determined and expressed as a ratio which compares visual quality scores "before" and "after" a proposed alteration.

(3) Viewer population size and sensitivity may modify the severity of visual impact, so long as the relative scarcity or uniqueness of the landscape is also considered within a larger regional context. Such "red flag" indicators protect remote areas as well as unusual natural and cultural sites of less obvious aesthetic significance from being developed solely on the basis of number of viewer contacts.

DISCOVERING A METHOD TO RATE VISUAL QUALITY

Several thoughts were stimulated by the old adage, "Beauty is in the eye of the beholder." Is "beauty" of the landscape determined solely by a person's taste, preference, cultural attitude, perception, feeling or intelligence (as the adage might lead us to believe), or rather does man respond to an intrinsic landscape aesthetic linked more directly to the landscape's expression of process and form?[4/] If there are identifiable landscape characteristics which evoke aesthetic response in man, what are their essential qualities and interrelationships?

The challenge lay in determining and articulating explicit criteria which contribute to landscape visual quality. By using these criteria, we hope to diminish individual bias and provide a more objective basis to determine visual quality than an overall judgement alone. The criteria would also be useful in identifying the qualitative strengths and weaknesses of a scene, and might indirectly suggest design

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[4/] For further discussion, see Jones (Spring 1975) and McHarg (1969).

options to improve the quality or to diminish the negative impacts of an alteration.

Our main test for the criteria was whether or not they could be articulated separately, and yet their ratings combined in a simple equation to yield scores which correlated closely with overall mean judgements of visual quality for a given scene. Due to a restricted budget, we had to limit our testing efforts to a small group of critical individuals familiar with a range of landscapes, who could be called upon to provide the equivalent of "expert testimony." Hence we turned to individuals with design-related backgrounds to test the criteria; their experience and insights proved valuable in clarifying the criteria and rating scales developed, and lent credibility to the methodology. (It should be noted, however, that we have successfully trained individuals from a wide range of backgrounds to apply the criteria equally well, and do not consider it an "elitist" approach; a certain degree of familiarity with the definitions and rating scales is all that is required. Later studies have revealed high correlations between "expert" ratings of scenes and those of the general public, although visual sensitivity to specific alterations may vary slightly between interest groups.[5])

We considered a number of criteria, including complexity, diversity, irregularity, mystery, prominence, variety, freedom from encroachment, distinctiveness, uniqueness, harmony, coherence, and others. These terms were suggested in works by Craik (1972), Crowe (1958), Jones (1966, 1973), Leopold (1969), Litton (1968, 1971), McHarg (1969) and Zube (1973). We found Litton's (1971) definitions of variety, vividness and unity particularly comprehensive. Zube's (1973) report that Kaplan and Wendt found a positive correlation between naturalness and individual landscape preferences also proved relevant.

We eventually tried to use the least possible number of terms, reducing them to those which were the most encompassing and significant, and could be applied easily to any scene. Two criteria which repeatedly proved significant included (a) Litton's "vividness" (using his "variety" as a component contributing to vividness), and (b) the naturalness/freedom-from-encroachment factor (Jones, 1973, Zube, 1973) which we called "intactness." However, numerical comparison between overall visual quality scores with those derived from these two criteria alone were not wholly successful. Another factor was necessary.

Remembering Frank Lloyd Wright's insistence upon "variety within unity" and returning to Litton's definition we made some evaluations using the three criteria of vividness, intactness and unity. We then found that a simple averaging of these criteria, weighted equally, yielded visual quality scores very consistent with mean overall ratings of various landscape scenes. Testing these criteria with other five-member groups from the design professions produced similar results. Thus we discovered that a landscape's visual quality can be measured by trained individuals using three criteria: (a) vividness - the landscape's memorability, (b) intactness - the wholeness or integrity of its order, and (c) unity - the compositional harmony of its parts. These criteria are briefly illustrated in figure 1.

The method we used both to test and to apply these criteria involves three different approaches or measurement levels, each of which provides independent visual quality scores for a given scene which can then be compared. For level one, an evaluator simply rates overall the visual quality of each scene on a 1-100 scale, where familiar "benchmark" landscapes are used as reference points along the scale. For level two, numerically-scaled definitions for vividness, intactness and unity are applied to yield ratings for the scene as a whole. These criteria are scored on a 1-7 scale for easy comprehension, and then averaged and converted to a 1-100 scale for direct comparison with level one. For level three, the scene is analyzed graphically into its distinctive individual parts[6] (water, sky, facility, foreground land/vegetation, background hills, etc.) and each part rated (1-7) for its vividness and intactness within the context of the overall scene. In addition, each part is rated according to its degree of visual contribution to the overall scene. This contribution becomes a weighting-factor used to place the scores for each part into proper perspective. Expressed numerically, these equations are:

Level 1: $VQ = \underline{\qquad}$ (scored 1-100)
Level 2: $VQ = (V+I+U) \div 3$ (scored 1-7)
Level 3: $VQ = (V'+I'+U) \div 3$ (scored 1-7)

Where VQ = Visual quality,
V = Vividness of overall scene
I = Intactness of overall scene
U = Unity of overall scene
V' = A weighted vividness score (the summation of vividness of each element times its importance, divided by the sum of all importance scores)

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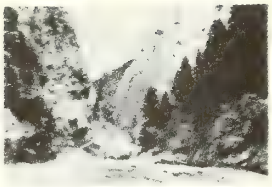
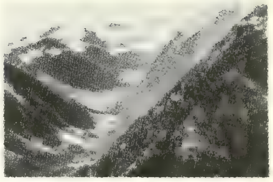
[5] See Blair (1976).

[6] See Jones (1966, 1973 and Spring 1975).

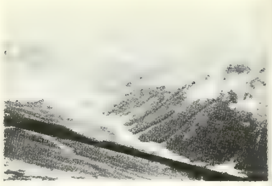
Vivid Skyline Boundary



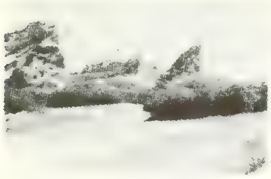
Vivid Spatial Enclosure



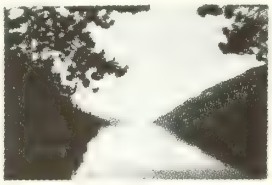
Vivid Topographic Relief



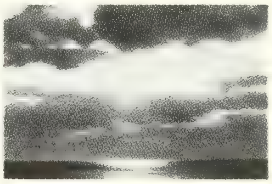
Vivid Vegetation Patterns



Vivid Landmark Features



Vivid Waterform



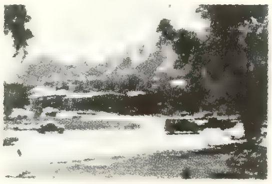
Vivid Skyform

Vivid Manmade Elements

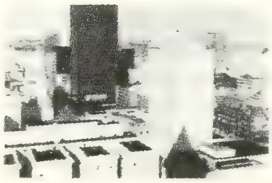
VIVIDNESS

High Degree of Intactness

Low Level of Development

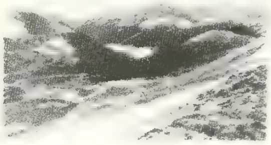


Moderate Level of Development



High Level of Development

Low Degree of Intactness

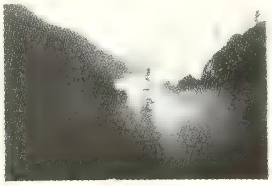


Low Degree of Encroachment

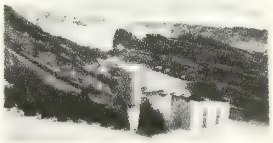
Moderate Encroachment

High Degree of Encroachment

INTACTNESS



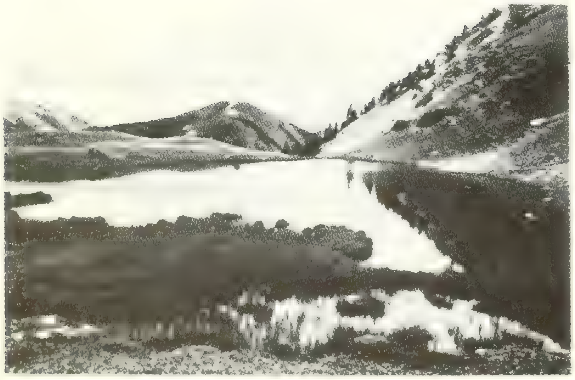
Overall Unity



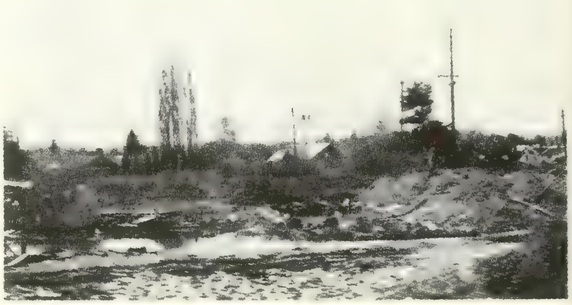
Unity Between Manmade & Natural Elements

UNITY

Figure 1--*Visual Quality Criteria Illustrations.*



VIVIDNESS
High · Low
+
INTACTNESS
High · Low
+
UNITY
High · Low
=
VISUAL QUALITY
High · Low



and I' = A weighted intactness score
(calculated as for V').

Measurement level 3 often yields visual quality scores most consistent with level 1, the overall rating. Rather than depend on one level alone, we suggest that all three measurements levels be utilized in the AEC model's visual quality evaluation procedure, and have developed a checklist to score factors for all three levels.[7/]

FILLING OUT THE FUNCTIONAL MODEL

Since the model had to be documented in a handbook format,we developed the step-by-step procedures outlined below.

Step 1--Survey the site for scarce visual resources. In line with Leopold's (1969) idea that unusual landscapes should be protected regardless of their visual quality, this step suggests that the visual resources of a potential site for a nuclear facility be looked at in larger regional landscape context to assess their relative commonness or scarcity. If unusual visual resources are present that would be threatened or altered by the facility, a "red flag" warning (Dee 1973) should be signalled and the site desirability reconsidered in context. This method also helps to protect unique sites in remote areas from being selected for development solely on the basis of low viewer contact.

Step 2--Construct the facility's viewshed. This visibility map documents the surrounding area from which a facility can be seen and aids the selection of representative viewpoints.

Step 3--Estimate population viewer contact with facility. Both resident and transient viewers are considered within the facility's viewshed. The AEC handbook outlines procedures to count number and frequency of viewer contacts per year within a given sector, and theorizes that since residents may become accustomed to the presence of a facility over time, their sensitivity to it may be slighty less than transients.[8/]

Step 4--Select representative viewpoints. Since it would be impossible to simulate and evaluate scenes of all proposed facility alternatives from every point in the viewshed, a method to select a limited number (8-12), of "most representative" viewpoints was necessary. We employed Litton's (1968) criteria of viewing distance (facility in foreground, middleground or background distance zones) and observer position (observer superior, normal or inferior to the facility) to suggest a representative distribution of viewpoints.

Step 5--Photograph the scene and simulate the facility. Views from at least 20 viewpoints are photographed within specified times of day and weather conditions. Then 8-12 views are selected for making facility alternatives and air-brushing. Slides of these simulated photographs are assessed by a team of evaluators.

Step 6--Evaluate visual quality. The team of trained evaluators are shown slides of "before" and "after" photographs and record their scores on a checklist using all three measurement levels of visual quality. Final scores are compared on a 1-100 scale and documented for each individual evaluator. Average scores are determined for the entire group.

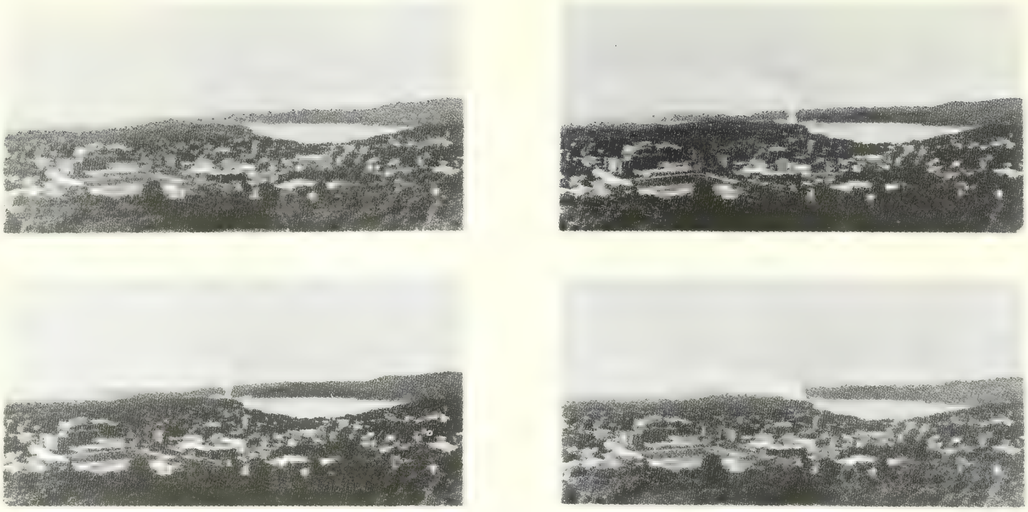
Step 7--Determining total visual impact. Final documentation includes the collection of "before" and "after" photographs evaluated with a tabulation of the following: (a) viewpoint name, (b) viewing distance, (c) the "before" and (d) the "after" visual quality score for each alternative as seen from that viewpoint, (e) the ratio of change in visual quality from that viewpoint (numerical difference in "before" and "after" score divided by the "before" score, expressing positive or negative change in the context of original visual quality), (f) population viewer contacts per year, (g) a derived population contact weighting factor, and (h) a visual impact score combining the ratio of change in visual quality (e) and population contact weighting factor (g). A brief report should accompany this data, summarizing the findings of the visual resource uniqueness survey conducted in step 1.

APPLYING THE MODEL AT INDIAN POINT

In 1975, Jones & Jones applied the AEC visual impact model to determine the impacts of single and double 565-foot high natural draft cooling towers, single and double 370-foot high fan-assisted natural draft cooling towers, and two or four 74-foot high circular mechanical draft towers, alternatives proposed for existing nuclear facilities at Indian Point on the Hudson River near Peekskill, New York (Jones, November 1975). See simulated alternatives from key viewpoints in figure 2, and overall viewshed in figure 3.

[7/] See Burnham (1974) or Jones (April 1975).

[8/] Differential viewer sensitivity issues are developed more fully in Hendrickson (1974), Blair (1976) and Driscoll (1976).



Existing: Visual Quality = 34

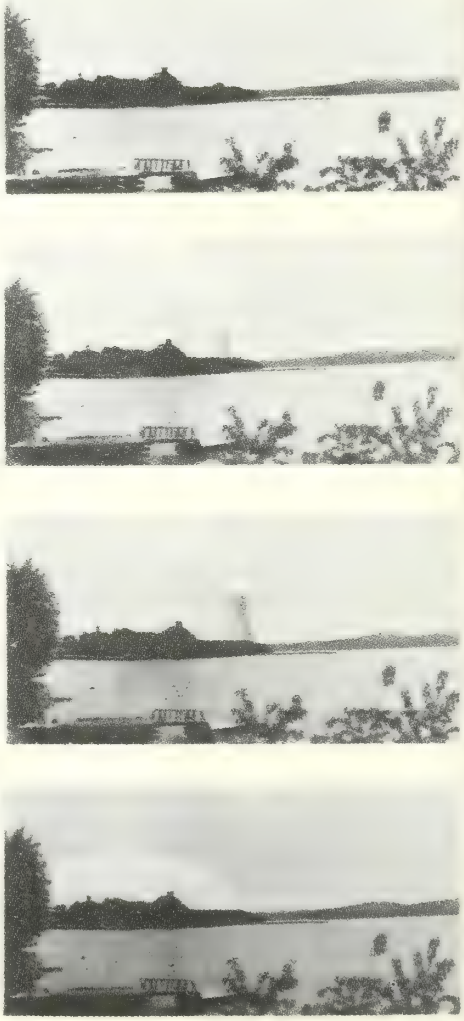
375' Tower Visual Quality = 48

565' Tower Visual Quality = 49

65' Towers Visual Quality = 56

Above: Hudson Overlook Apartments
High Viewing Population, 2½ miles away

Figure 2--*Cooling tower alternatives as seen from selected viewpoints.*
below: Peekskill Waterfront
High Viewing Population, 7/8 miles away



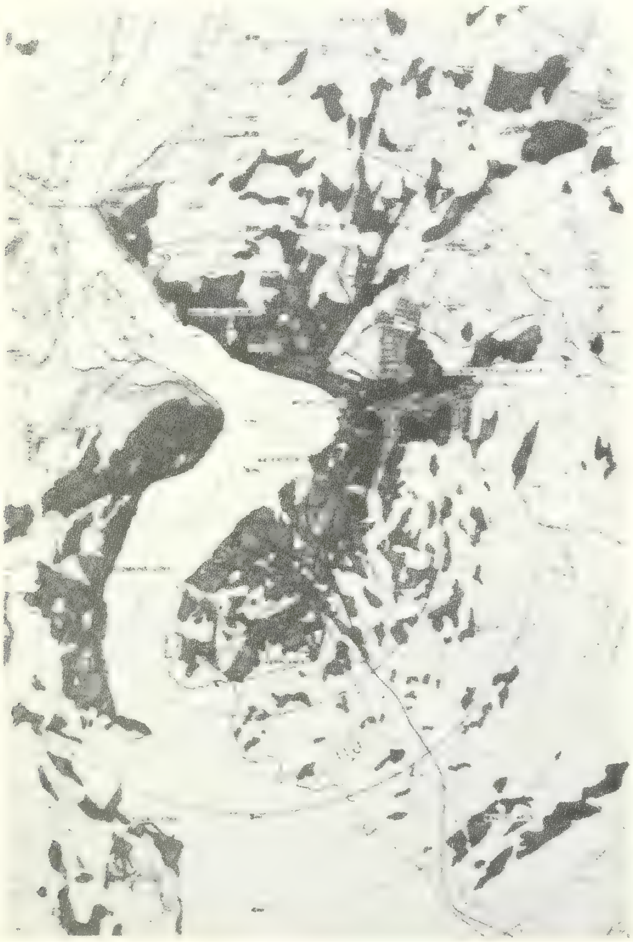
Existing; Visual Quality = 35

375' Tower Visual Quality = 54

565' Tower Visual Quality = 58

65' Towers Visual Quality = 60

Figure 3--*Indian Point shaded viewshed of 565'-high natural draft cooling tower alternative for unit number 2. Solid concentric circles at 1-mile distance intervals.*



All the options evaluated diminish the overall visual quality of the surrounding viewshed, except for the 565-foot and 370-foot tower alternatives as evaluated from two viewpoints for level 2. The taller towers and steam plumes added overall visual interest (vividness) to these two scenes, which offset the reduction of each scene's intactness and unity. Surprisingly, the special-competence group's scores consistently indicated that either of the taller hyperbolic parabaloid tower options diminished visual quality less from most viewpoints than the shorter, less-visible 74-foot high towers.

Simulating the size and density of the vapor plume, as specified by the NRC's consulting meteorologist, was a problem. As often happens in the preparation of an EIS, the meteorological studies required to determine the vapor plume configuration were conducted concurrently with the visual impact study. In fact the billowing plumes we were directed to simulate in all views were the result of an extreme weather condition and would occur less than two percent of the time.

The low circular mechanical draft towers were criticized by the evaluators because the sources of the plume were not visible from most viewpoints, producing the appearance of a major ground fire, geyser or minor volcanic eruption. In contrast, an equally dense plume pouring from the taller towers enhanced their form. The NRC counter-argued our study's findings by pointing out the rare occurrence of such extreme plumes, suggesting a more thorough analysis of the problem would require evaluation of both a wider variety of plumes, and plumeless conditions. The NRC also suggested more exploration of the resident viewers' tendency to accept the presence of vapor plumes over time (USNRC 1976).

EVALUATING THE MODEL'S PERFORMANCE

With the exception of the above-mentioned suggestions to improve the model, its performance has been very satisfactory and stood up well to the tests of time. Using vividness, intactness and unity as criteria for the evaluation procedure have proved to be successful in a wide variety of project applications in wild and urban settings throughout the U.S. In retrospect, the experience gained in the formulation and application of this methodology has confirmed our belief that landscape aesthetics can be measured and dealt with in a tangible way.

Some questions that were unresolved in 1973 have since been answered in subsequent work. In particular, there is an important distinction between visual quality and visual character (Jones & Jones 1978 and Ady 1979). The visual character of a landscape may undergo complete transformation without changes in its visual quality score; the inverse is also true. "Visual impact" needs to be redefined as "the change in visual character and/or visual quality over time resulting from an alteration of the landscape, as viewed from the surrounding area." Visual character is closely related to individual preference; one person may prefer the visual character of a golf course over that of a mixed forest, for example, but the visual quality of both settings could be equal.

Development of criteria to predict visual compatibility between proposed alterations and the landscape setting has continued (Hendrickson 1974, Blair 1976, Driscoll 1976, Jones & Jones 1978). These criteria can be applied to large landscapes to assess the potential visual impacts of linear features such as transmission lines, highways and roads, making route selection and alignment decisions easier. The criteria can also be used to suggest design changes to increase visual compatibility and diminish change in (or even enhance) visual character and quality. Techniques to classify the landscape undergo refinement continually (Jones 1966, 1973; Jones & Jones 1974, 1978; Blair 1976; Driscoll 1976; Ady 1979). Viewer sensitivity issues have been identified and dealt with in a more sophisticated manner (Hendrickson 1974; Blair 1976; Jones & Jones 1978; Ady 1979). An empirical model has also emerged for determining the visibility levels of landscape elements at various distances in relation to an object's size and degree of contrast with its setting (Driscoll 1976).

In order to evaluate visual quality in urban settings the definition of intactness has been expanded to mean "the integrity of visual order in the natural and man-built landscape, and the extent to which that landscape is free from visual encroachment" (Jones & Jones 1978). We hope to continue to expand ways to manage the visual resources of our national landscape.

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Visual Sensitivity of River Recreation to Power Plants[1]

David H. Blau and Michael C. Bowie[2]

Abstract: The consultants were asked by the Power Plant Siting Staff of the Minnesota Environmental Quality Council to develop a methodology for evaluating the sensitivity of river-related recreational activities to visual intrusion by large coal-fired power plants. The methodology, which is applicable to any major stream in the state, was developed and tested on a case study river.

The methodology involves two basic tracks: landscape character and recreational potential. The landscape character track defines and measures power plant visual characteristics and river-related landscape categories. These are correlated and the potential for visual absorption of a power plant is determined for each landscape type. These visual absorption values are then mapped along the case study river. The recreational potential track assesses the suitability of each segment of the river for various recreational activities. Each potential activity is assigned to one of three classes of importance and sensitivity to visual intrusion and the resulting recreation values are mapped.

A mapped correlation of the visual absorption values and the recreation values reveals power plant siting constraints and opportunities and can be used by the MEQC in regulating and guiding the location of proposed power plants.

INTRODUCTION

The State of Minnesota anticipates the construction of a considerable number of large new coal-fired power plants in the next one or two decades. Most of these will be located near a source of cooling water which means, generally, near a river, and the rivers in the state are heavily and increasingly used for recreation.

The larger scale and industrial character of a power plant conflict with the natural landscape values that are necessary, at least in some degree, to more river-related recreation.

In April 1977, the Minnesota Environmental Quality Council asked the authors to develop a methodology for assessing the relative sensitivity (with respect to recreational potential) of Minnesota's rivers to the location of large power plants.

The methodology is intended for use by the MEQC in regulating and providing guidance on the location of proposed power plants. The system can also be used by utility companies for identifying siting opportunities relative to river recreation and comparing the merits of alternative power plant sites on the same river or on different ones.

Although the methodology is based to some extent on subjective judgement, it offers the MEQC a consistent and rational approach to the review of power plant siting applications from river to river and year to year. The step-by-step process provides a framework for communications between the utilities and the MEQC.

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[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Principal; and Senior Associate; EDAW, Inc., 50 Green Street, San Francisco, California 94111.

The methodology should lead naturally into more detailed studies of promising candidate sites. While no estimates of cost per proposed site or per river mile surveyed can be made at this stage of development, the system should prove rapid and economical as well as capable of being used by nonspecialized agency personnel.

It is envisioned that the methodology will be refined and improved each time it is applied.

The methodology was evolved and tested using, as a case study, two stretches of the Minnesota River.

The methodology proceeds along two parallel tracks:

- The Landscape Character Track: Power plant and river-related landscape characteristics are determined. The visual absorption potential of various landscapes is determined and the absorption potential of the case study river is illustrated.
- The Recreation Potential Track: The existing and potential recreational activities along the case study river are identified. Their sensitivity to visual intrusion and their relative importance are assessed.

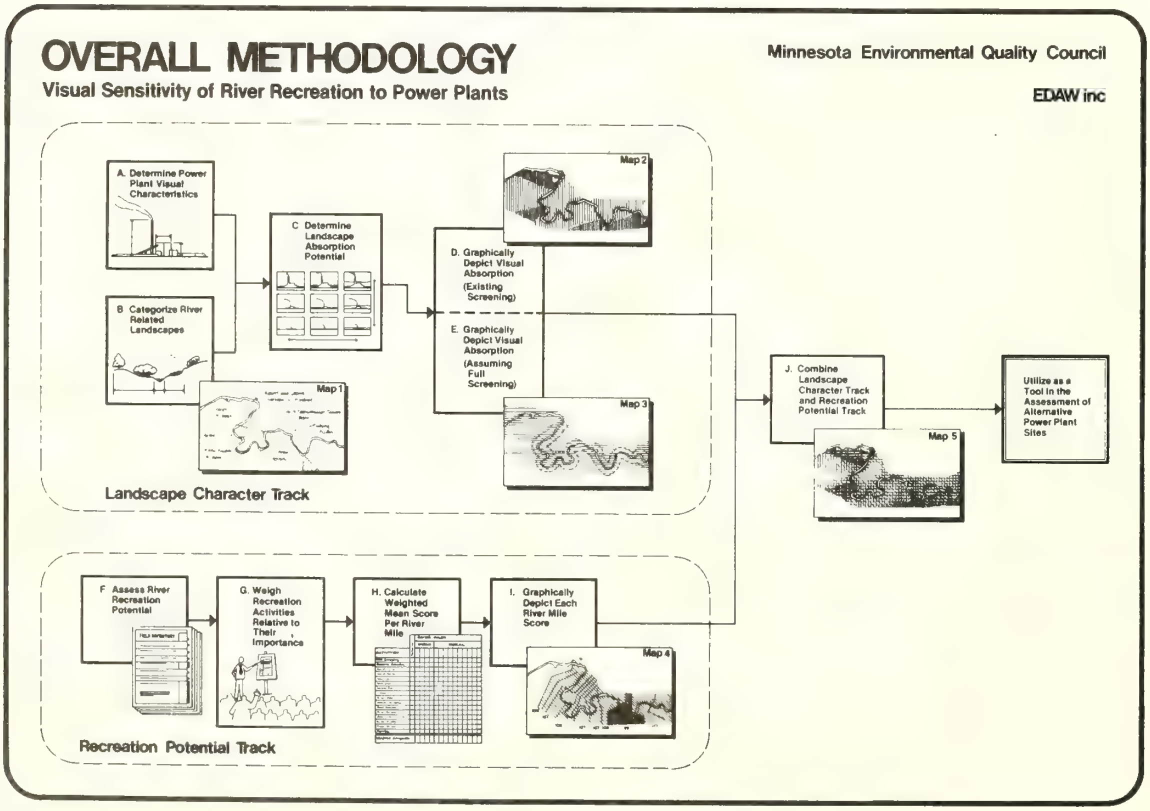
The steps along these two tracks are illustrated on the Overall Methodology Diagram.

LANDSCAPE CHARACTER TRACK

The Landscape Character Track (which proceeds parallel to the Recreation Potential Track), defines and measures two variables; power plant visual characteristics and river-related landscape categories. These are correlated and the potential for visual absorption of a power plant is determined for a range of landscape types. The absorption potential values are then mapped along the case study river. A methodology for numerically evaluating the relative intrusion value of proposed power plants is also presented. Note, however, that no specifically sited plants are evaluated in this study.

STEP A. DETERMINE POWER PLANT VISUAL CHARACTERISTICS

When a major new power plant is constructed near a river, it is likely to exceed by fa extent and in the scale of its structures, any


OVERALL METHODOLOGY
Visual Sensitivity of River Recreation to Power Plants
Minnesota Environmental Quality Council
EDAW inc
A. Determine Power Plant Visual Characteristics
B Categorize River Related Landscapes
C Determine Landscape Absorption Potential
Map 1
Map 2
D. Graphically Depict Visual Absorption (Existing Screening)
E. Graphically Depict Visual Absorption (Assuming Full Screening)
Map 3
Landscape Character Track
J. Combine Landscape Character Track and Recreation Potential Track
Map 5
Utilize as a Tool in the Assessment of Alternative Power Plant Sites
F Assess River Recreation Potential
G. Weigh Recreation Activities Relative to Their Importance
H. Calculate Weighted Mean Score Per River Mile
I. Graphically Depict Each River Mile Score
Map 4
Recreation Potential Track

other facility within many miles. Large plants require a site of several square miles and have boiler buildings up to 250 feet high. Based on current air quality laws and pollution control technology, it is assumed that all future coal-fired plants in Minnesota will have stacks 650 feet high.

Figure 1 illustrates the visual characteristics of a typical power plant. The illustration is arranged to show, as far as possible, the "fuel in - electricity out" process from left to right.

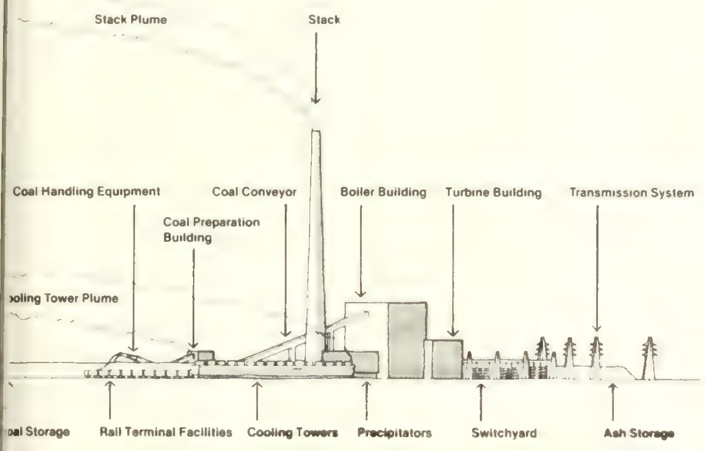


Figure 1

STEP B. CATEGORIZE RIVER RELATED LANDSCAPES

As a first move towards understanding any river corridor, its topography should be examined using maps and aerial photographs and its general physical characteristics noted.

Only a limited and general idea of the characteristics of a river corridor can be derived from published sources. In order to properly categorize its landscapes, it is essential to experience the river directly by floating it. For the case study river, this was done by canoe.

In the course of the survey, the following conditions were observed: bank height and type; screening; level and type of development; and views out to bluffs.

The observations were recorded on field notes, which became the basis of Map 1. Existing Conditions.

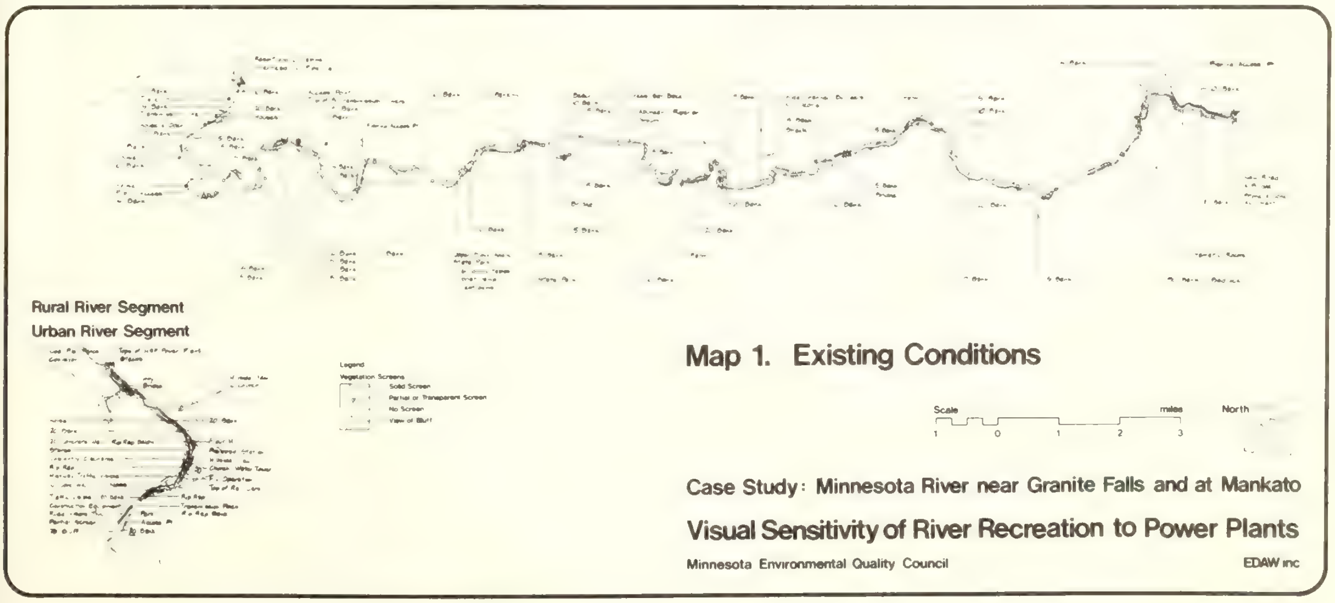
STEP C. DETERMINE LANDSCAPE ABSORPTION POTENTIAL

There are two reasons for examining landscape absorption potential:

1. To enable maps to be produced that reveal power plant visual siting opportunities and constraints. How this was done for the case study river is explained in Steps D and E.

2. To allow comparison of alternate sites by developing a methodology that applies a numerical intrusion value to power plants with various combinations of absorption factors. A proposed methodology is outlined in this step.

The most important factors that influence the intrusion that a specific power plant has on a specific recreational use are:


Rural River Segment
Urban River Segment
Legend
Vegetation Screens
Solid Screen
Partial or Transparent Screen
No Screen
View of Bluff
Map 1. Existing Conditions
Scale
miles
1
0
1
2
3
North
Case Study: Minnesota River near Granite Falls and at Mankato
Visual Sensitivity of River Recreation to Power Plants
Minnesota Environmental Quality Council
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- Level of Development: The higher the existing level of development, the lower the intrusion. The following categories are used:

  - Natural
  - Rural
  - Transitional
  - Urban
  - Industrial

- Screening. The value of screening in reducing visual intrusion is self-evident. However, low screening that conceals the many low, but widespread and untidy elements of a power plant may be of disproportionately high value.

- Backdrop. Backdrop to a plant is generally felt to reduce its visual intrusion. In other words, if in a given view, a plant is fully silhouetted against the sky, its visual intrusion is greater than if it is partly backed by topographic features, mainly because the tone contrast between power plant and sky is greater than that between plant and land.

- Distance from Observer. When the sizes of the major elements of a power plant are known, given certain assumptions of the human "cone of vision", the appearance of the plant within the field of view at various distances can be illustrated and its intrusion assessed.

Figure 2 illustrates, in diagrammatic form, a typical 300 MW power plant at distance of one-half mile, one mile and two miles from the viewer with various combinations of screening and backdrop. The figure also shows, for illustration, a judgemental visual intrusion value for each combination of these factors.

If a number of potential power plant locations were being compared and reasonably exact data were available on the size and locations of the plants and their visibility from the river segments, actual numerical valu could be evolved with the input of the recreational user of the river. The values would then be factored in three additional ways:

A. To modify, if necessary, for existing partial or transparent screens.

Visual Intrusion Values Relative to Distance, Screening and Backdrop
800 MW Single Unit Coal Fired Power Plant

Notes:
Illustrative Visual Intrusion Value. 1 is Lowest, 24 is Highest.
All Screening is Solid.
The Frame of Each Illustration Represents the Full Field of View.

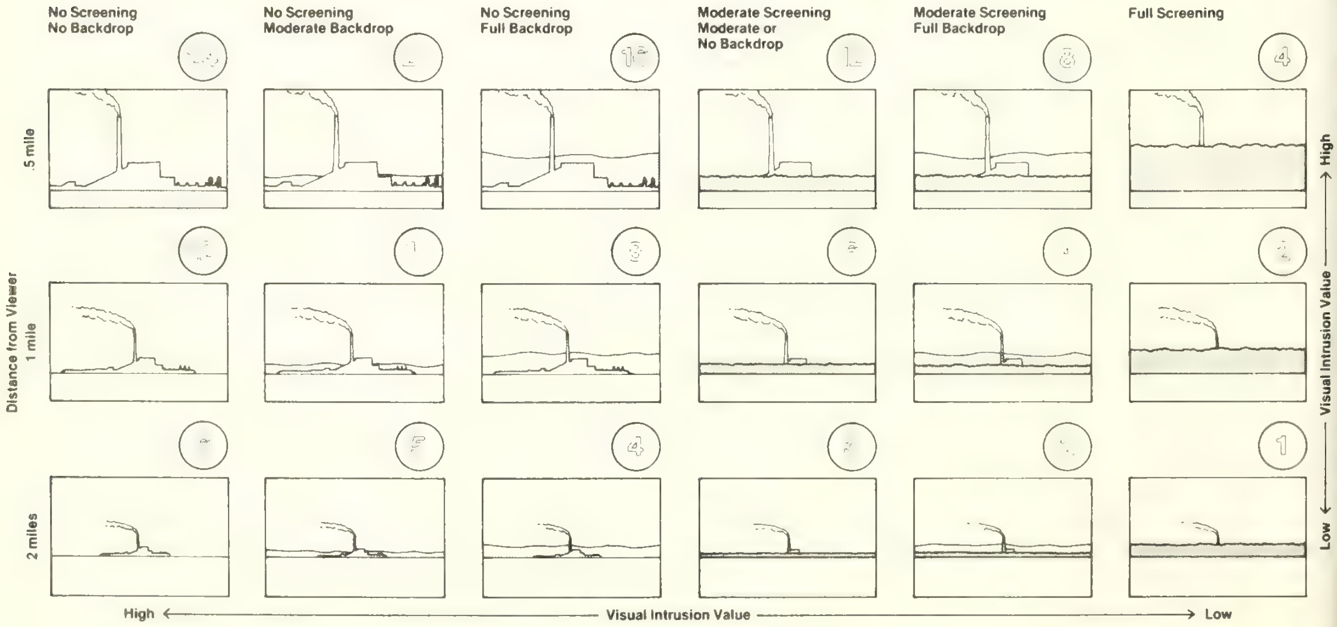


Figure 2

B. To modify for development level. Some such scale as the following is suggested (using the development levels outlined above):

Natural - multiply by 16
Rural - multiply by 8
Transitional - multiply by 4
Urban - multiply by 2
Industrial - multiply by 1

C. To modify for recreational importance as explained in the Recreation Sensitivity Track.

The ultimate result would be a single numerical value representing the potential visual intrusion of each alternate plant site on its river.

STEP D. GRAPHICALLY DEPICT VISUAL ABSORPTION: MAP VIEWSHEDS AT GROUND LEVEL WITH EXISTING SCREENING & MAP EXISTING DEVELOPMENT LEVEL

The map that illustrates this step (Map 2. Visual Absorption: Existing Screening and Development), shows the viewsheds that result from looking across the banks of the case study river (at ground level, without elevating the view, i.e., ignoring anything that might be visible above the trees), where the bank screening conditions remain as they exist at the time of the site survey.

The viewsheds were determined by placing an imaginary viewer on the river at each point along its centerline and mapping his viewshed out across each bank to the limits of the study corridor, the main bluff line. The viewsheds were delineated as full when no bank screening was present and as partial when transparent screening existed. No viewsheds were shown behind solid screening.

STEP E. GRAPHICALLY DEPICT VISUAL ABSORPTION: DETERMINE VIEWSHEDS FOR TALL POWER PLANT STRUCTURES ASSUMING FULL SCREENING

Figures 3 and 4 illustrate the average expected height of future power plants.

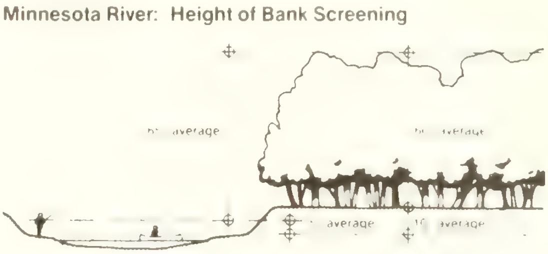

Minnesota River: Height of Bank Screening

Figure 3

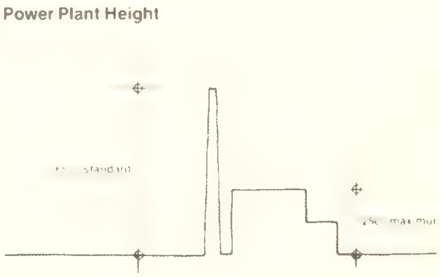
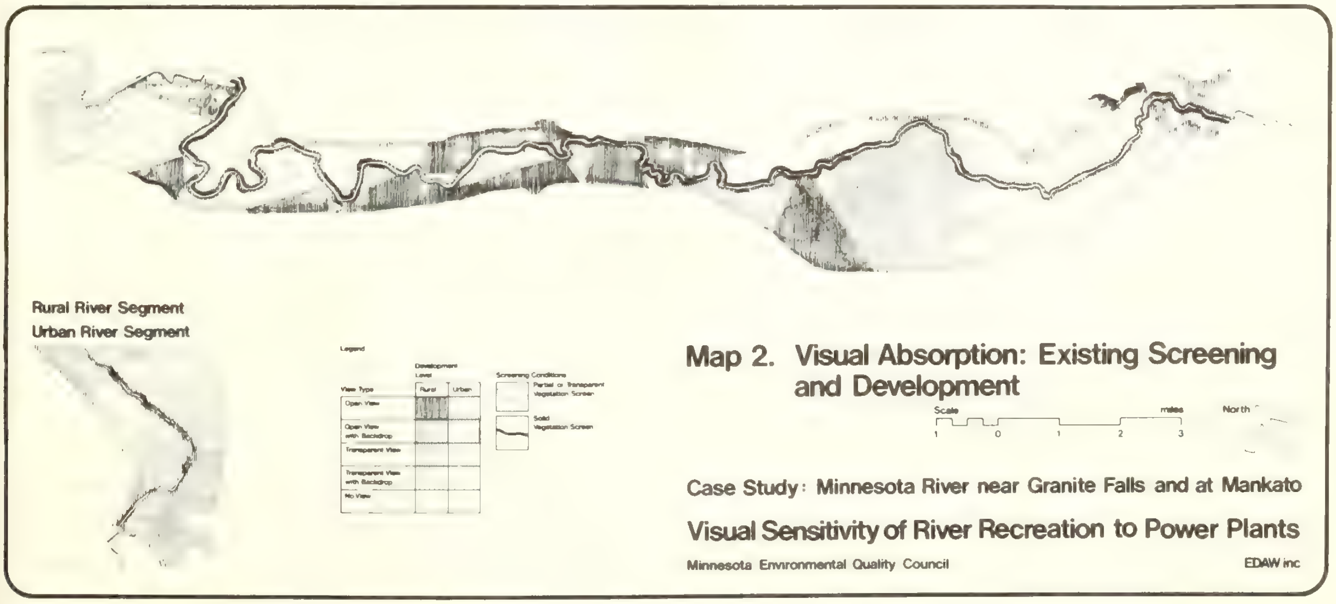

Power Plant Height

Figure 4



Map 2. Visual Absorption: Existing Screening and Development

Case Study: Minnesota River near Granite Falls and at Mankato

Visual Sensitivity of River Recreation to Power Plants

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Figure 5 combines these two sets for facts, defines a reasonable visual intrusion level (where only the top half of the stack is visible) and shows how, on this river, a power plant must be set back behind the bank screen a distance equal to five times the distance between the observer and the screen.

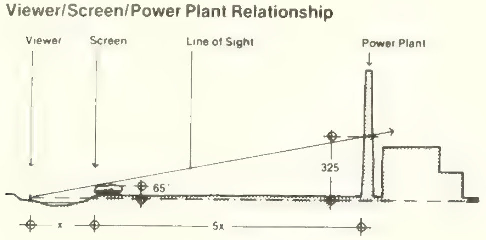

Figure 5

Other ratios will result from different screen heights and power plant heights. Other figures, resulting in different ratios, can be selected, as desired, to express more or less restrictive siting criteria.

The viewsheds over the fully-screened banks of the river can now be defined by applying the above ratios. For the case study river, the view was placed (a) at all points along the foot of each bank looking across the opposite bank screen and (b) in the center of the river looking up and down all straight river segments.

The viewsheds that resulted are illustrated on Map 3. Visual Absorption: Full Screening.

RECREATION POTENTIAL TRACK

Simultaneously with the performance of tasks along the Landscape Character Track, an assessment must be made of the recreation potential and sensitivity to visual intrusion by a power plant along the study river. This series of tasks is referred to as the Recreation Potential Track.

The assessment technique selected for use is the RIVERS Method.[3] Sixteen recreation activities are included in the evaluation. These are:

- Wild canoeing
- Hiking
- Canoe camping
- Trail camping
- General canoeing
- Small boating
- Swimming
- Nature study
- Picnicking
- Road camping
- Hunting
- Power boating
- Water skiing
- Pleasure driving
- Bank fishing
- Boat fishing

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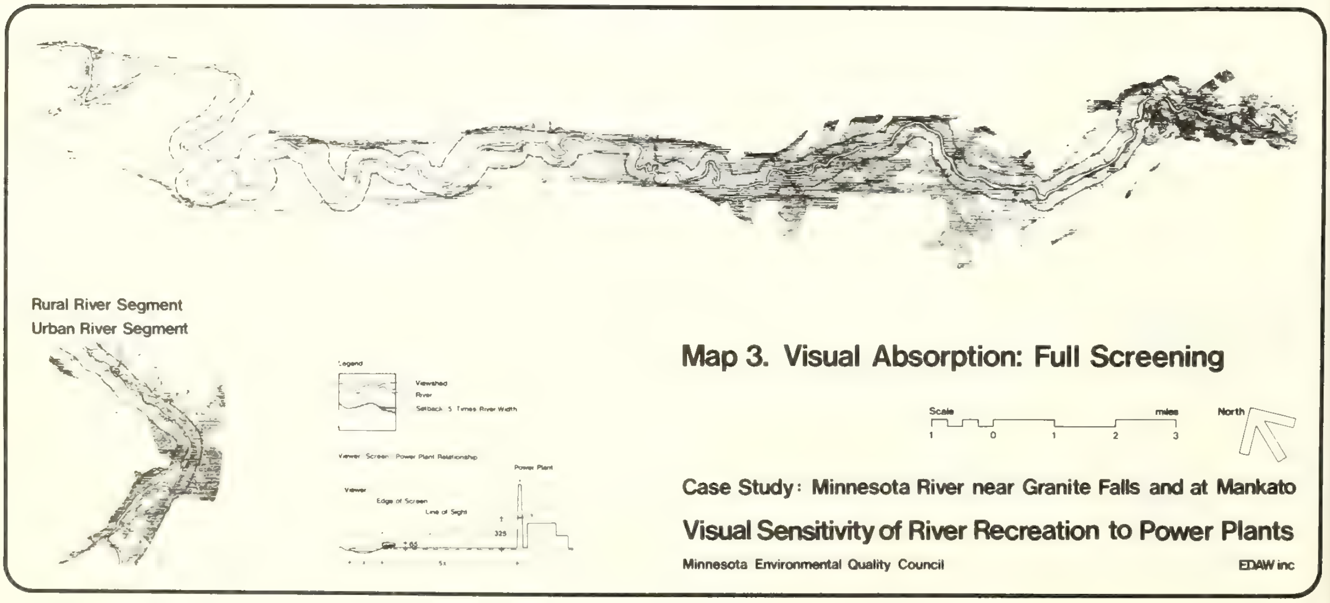
[3] Chubb, Michael and Eric H. Bauman, The RIVERS Method, A Pilot Study of River Recreation Potential Assessment. Department of Geography, Michigan State University and North Central Forest Experiment Station, U.S. Forest Service, 1976.



Map 3. Visual Absorption: Full Screening

Case Study: Minnesota River near Granite Falls and at Mankato

Visual Sensitivity of River Recreation to Power Plants

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The river corridor features included in the evaluation process are grouped into physical, water quality, soils, biological, land use, esthetic and accessibility factors.

STEP F. ASSESS RIVER RECREATION POTENTIAL

The procedure for assessing the recreation potential for the river under study is as follows:

- Delineate one-mile segments along the center line of the selected river.
- Prepare an inventory form for each river segment and enter as much information on the forms as possible from interpretation of aerial photographs and base maps and from government agencies.
- Conduct field survey by floating down the river, making observations, entering the remaining information on the forms and checking previously entered data at the end of each river mile.
- Calculate the suitability scores for each activity for each river mile.

A five-point scaling system is used to rate the river corridor features relative to each factor.

All scores are converted to a percentage of the total maximum score and shown in a matrix format with the river miles along the horizontal axis and the 16 recreational activities along the vertical axis.

The scores show that the river is of moderate to high value for recreation, neither exceptionally good for most activities nor, even in the urban segment, unusually poor.

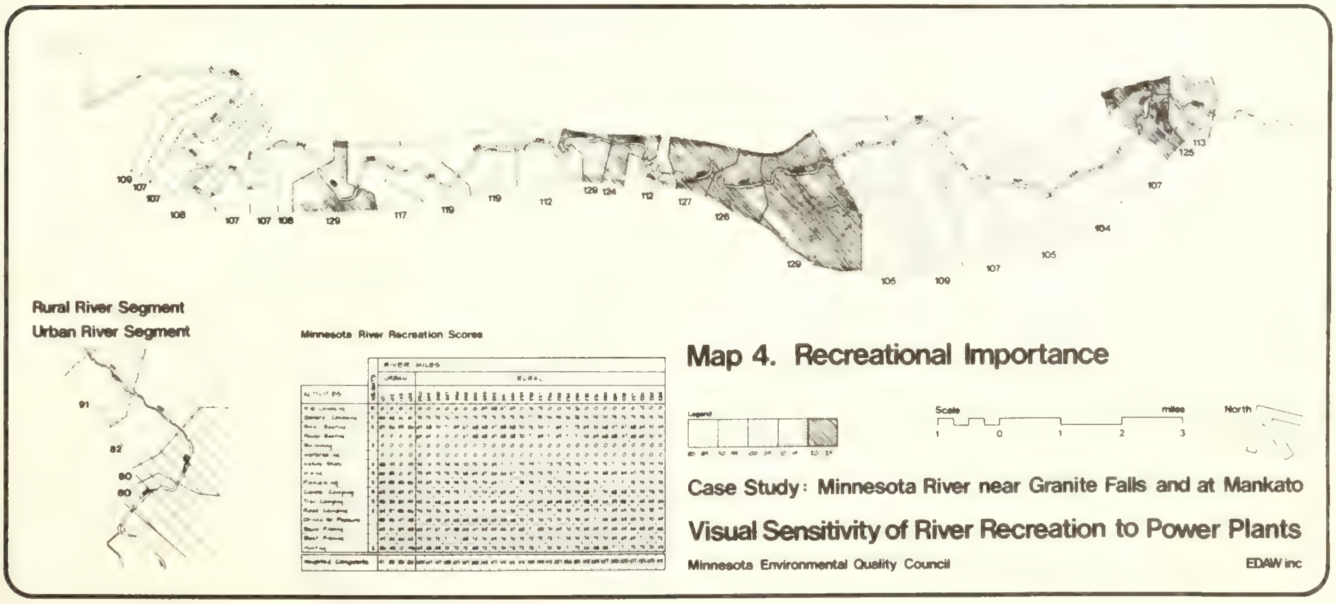
STEP G. WEIGH RECREATION ACTIVITIES RELATIVE TO THEIR IMPORTANCE

Since the 16 activities are not only affected differently (e.g., the presence of a plant would greatly diminish the wild canoeing experience, while having perhaps a minor effect on a power boating experience), but differ in their relative importance, it was felt desirable to "weigh" the 16 activities to reflect their relative value more accurately.

For illustration purposes, a simple numeric scale of 1, 2 and 3 has been used for the case study.

In practice, as this methodology is applied to other Minnesota rivers, it is recommended that the relative importance of the recreation activities be determined separately for each river by those people most concerned with the river resource -- the recreationists who use it.

This weighing of activities for the case study river is shown as the first column in the matrix on Map 4. Recreational Importance.



Map 4. Recreational Importance

Case Study: Minnesota River near Granite Falls and at Mankato

Visual Sensitivity of River Recreation to Power Plants

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STEP H. CALCULATE WEIGHTED MEAN SCORE PER RIVER MILE

The unweighted score for each recreation activity is then multiplied by the weight, the products are summed by river mile and divided by 16 to give one score per river mile. This score is shown across the bottom of the matrix on Map 4. Recreational Importance and represents the importance of recreational potential per river mile.

STEP I. GRAPHICALLY DEPICT EACH RIVER MILE SCORE

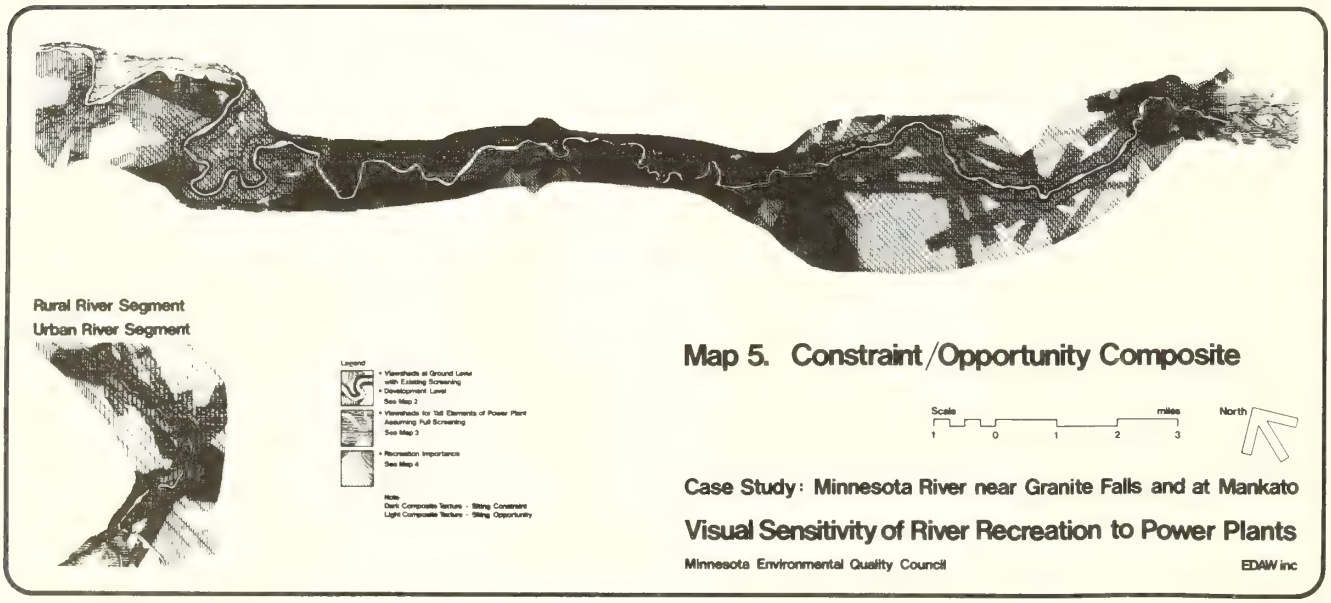
The range of possible scores per river mile using the numerical weighting outline in Step G. is 0 (if no potential existed for any of the 16 activities), to 199 (if conditions were ideal for all 16 activities). The weighted scores for the study river range from a low of 80 to a high of 129.

The range of 49 points was shown on Map 4. Recreational Importance as five graphic patterns each representing a 10-point spread. The darker the intensity of pattern, the higher the score, and thus the greater the importance of the river mile for potential recreational use.

STEP J. COMBINE LANDSCAPE CHARACTER TRACK AND RECREATION POTENTIAL TRACK

The map that illustrates this step (Map 5. Constraint/Opportunity Composite), results from overlaying Maps 2, 3 and 4. Each of these shows a range of siting constraints and opportunities by graphic textures; the darker the texture, the more constraining the siting consideration.

When these three maps are overlaid, the results (Map 5) show a complete picture of the visual siting constraints and opportunities along the case study river stretches, represented by dark and light composite textures.


Rural River Segment
Urban River Segment
Legend
• Viewsheds at Ground Level with Existing Screening
• Development Level
See Map 2
• Viewsheds for Tall Elements of Power Plant Assuming Full Screening
See Map 3
• Recreation Importance
See Map 4
Note:
Dark Composite Texture - Siting Constraint
Light Composite Texture - Siting Opportunity
Scale
miles
1
0
1
2
3
North

Map 5. Constraint/Opportunity Composite

Case Study: Minnesota River near Granite Falls and at Mankato

Visual Sensitivity of River Recreation to Power Plants

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Classification of the Visual Landscape for Transmission Planning[1]

Curtis Miller[2], Nargis Jetha[3] Rod MacDonald[4]

Abstract: The Visual Landscape Type Classification method of the Route and Site Selection Division, Ontario Hydro, defines and delineates the landscape into discrete visual units using parametric and judgmental data. This qualitative and quantitative information is documented in a prescribed format to give each of the approximately 1100 Landscape Types a unique description. Utilizing the Landscape Types and evaluation critera, an assessment can be made of the visual change to the landscape due to the introduction of transmission facilities. This paper elaborates on the effective application of Landscape Types in the Transmission Route Planning Process.

INTRODUCTION

The Visual Landscape Type classification method of the Route and Site Selection Division, Ontario Hydro was developed to define and structure the landscape into discrete visual units for use in a comprehensive Transmission Route Planning Process. The landscape, by virtue of its visual character, can be disaggregated into a hierarchy of visual types determined by identified measurable and perceived visual differences in the landscape at each level. This paper will concentrate on a method designed to operate at a regional level and be influenced by regional concerns in the location of broad band transmission corridors.

Assumptions

There are three underlying concepts associated with the visual impacts of transmission facilities. The first concept is that transmission facilities will change the character of a Landscape Type through which it passes. The degree of change is predictable and a viewer's perception of this change will likely result in a negative emotional response.

The second concept is that the viewer is conditioned to expect certain visual images associated with specific land uses. Transmission facilities often conflict with these expectations and are likely to result in a negative response.

The third concept is that the specific design of transmission towers can result in a negative response from a potential viewer. The degree of response is a function of the tower size, tower style and number of lines.

These concepts must be integrated to achieve a full understanding of the visual impact of transmission facilities. This paper, however, focuses on the first concept and attempts to demonstrate the degree of change to the character of any Landscape Type caused by a transmission facility. The objective of the overall planning process is to avoid, where possible, those types which would be most severely affected by the imposition of a line or the elimination of a landscape element.

Data Handling

In order to define and delineate the landscape into discrete visual units, parametric and judgmental data are collected. This information is documented to give each of the 1100 Landscape Types a unique description. For ease of data storage, retrieval and manipulation, Ontario Hydro has developed a computer system[5] to aid in regional siting studies. A unit area of $4km^2$ defined by a 2km by 2km grid referenced to the Universal Traverse Mercator (UTM) grid system is the basic unit for data classification collected at a scale of 1:250,000.

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[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Project Manager, Wirth Associates, Phoenix, Arizona 85016

[3] Planner, Route and Site Selection Division, Ontario Hydro, Toronto, Ontario M5G1X6

[4] Principal, Land Plan Collaborative Limited, Guelph, Ontario NIH4E6

[5] Vaughn, A. V. 1976. Details and Possible Future of the Computer Assisted Route/Site Selection System, Ontario Hydro, Toronto, Ontario. Unpublished Document. 14 p.

DEVELOPMENT OF LANDSCAPE TYPES

To circumvent deficiencies inherent in qualitative approaches to land system classification, an inventory process consisting of the systematic recognition, interpretation and analysis of the visual structure of the landscape was developed. In an evaluative method of visual sensitivity and impact analysis which stresses visual relationships between observers, installation and landscape, it becomes imperative that parameters are quantified in an objective manner. The measurable parameters were: landform/relative relief, water cover and forest cover.

Landform/Relative Relief

Landform is the most representative indicator of visual character in the landscape. Landform is the major visual constant, the major space-defining element in the Ontario landscape. Morphological characteristics can be inventoried directly from aerial photographs or, as is undertaken at Ontario Hydro, determined in a systematic manner (MacDonald, 1974).

Relative Relief, as defined in the inventory process, is a measure of the total change in elevation within each 2km by 2km grid cell. To gauge relative relief, measurements are read from 1:50,000 scale topographic maps and are accurate to the nearest 25 feet. The difference between the highest and lowest contour line found in each cell is taken as the measure of relative relief

Cells of similar relative relief are grouped and unit boundaries are determined. This clustering process results in an objective classification of grid cells based on the relative relief element.

Water Cover

Water is a fairly constant indicator of visual character in the Ontario Landscape. Percentages of water cover in each 2km by 2km grid cell are recorded utilizing a dot screen method[6]. A dot screen containing 100 evenly spaced dots in each grid cell, at the 1:50,000 scale, is overlaid on a typographic map. Dots that fall within water bodies are counted and the percentage encoded for that cell. Boundaries encompassing areas of similar water cover percentages are drawn.

Forest Cover

Percent forest cover values are calculated for each 2km grid cell utilizing the dot screen method outlined above. Although percent forest cover is a variable indicator of visual character and gives no indication of the distribution or variability of cover within individual cells, it does provide a relative measure for comparing the differences between units. Cells with a similar percentage of forest cover are grouped and boundaries formed to enclose these homogeneous areas.

Aggregation

Landscape Types (Figure 1) are created by overlaying the units generated from the above three data maps of relative relief, water cover and forest cover. Where there are questions of boundary location between Landscape Types, aerial photographs, topographic maps, field observations and the collection of further information described below aids in the stabilization of those boundaries.

Non-parametric Data

The collection of non-parametric data may include forest and water patterns, degree of man-modification and openness. This additional information, along with the parametric data, is documented in a standardized format illustrated in Figure 2 Non-parametric data aids in: deciding whether large units can be broken down into smaller units, notes where changes (boundaries) may occur between Landscape Types and how dramatic or self-evident they are, and distinguishes physical features or development patterns which because of cultural/historical associations may make an area unique. In addition, this classification process establishes a consistent nomenclature for inventorying the diverse aspects of the landscape of Ontario.

Aerial photographs and ground surveillance are the primary data sources throughout this portion of the inventory process. Consequently, patterns that are visible from the air often play a major role in determining the description of a given area. Unfortunately, some patterns are not readily discernable at ground level. Regardless of this perceptual handicap, this information provides vital clues to the character of the visual landscape[7]

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[6] Holt, V. S. 1977. Guidelines for Developing Landscape Units for Visual Impact Assessment. Ontario Hydro, Toronto, Ontario. Unpublished document. 5 p.

[7] Podealuk, Fred T. 1977. Visual Resources: Definition of Terminology. Ontario Hydro, Toronto Ontario. Unpublished document. 42 p.

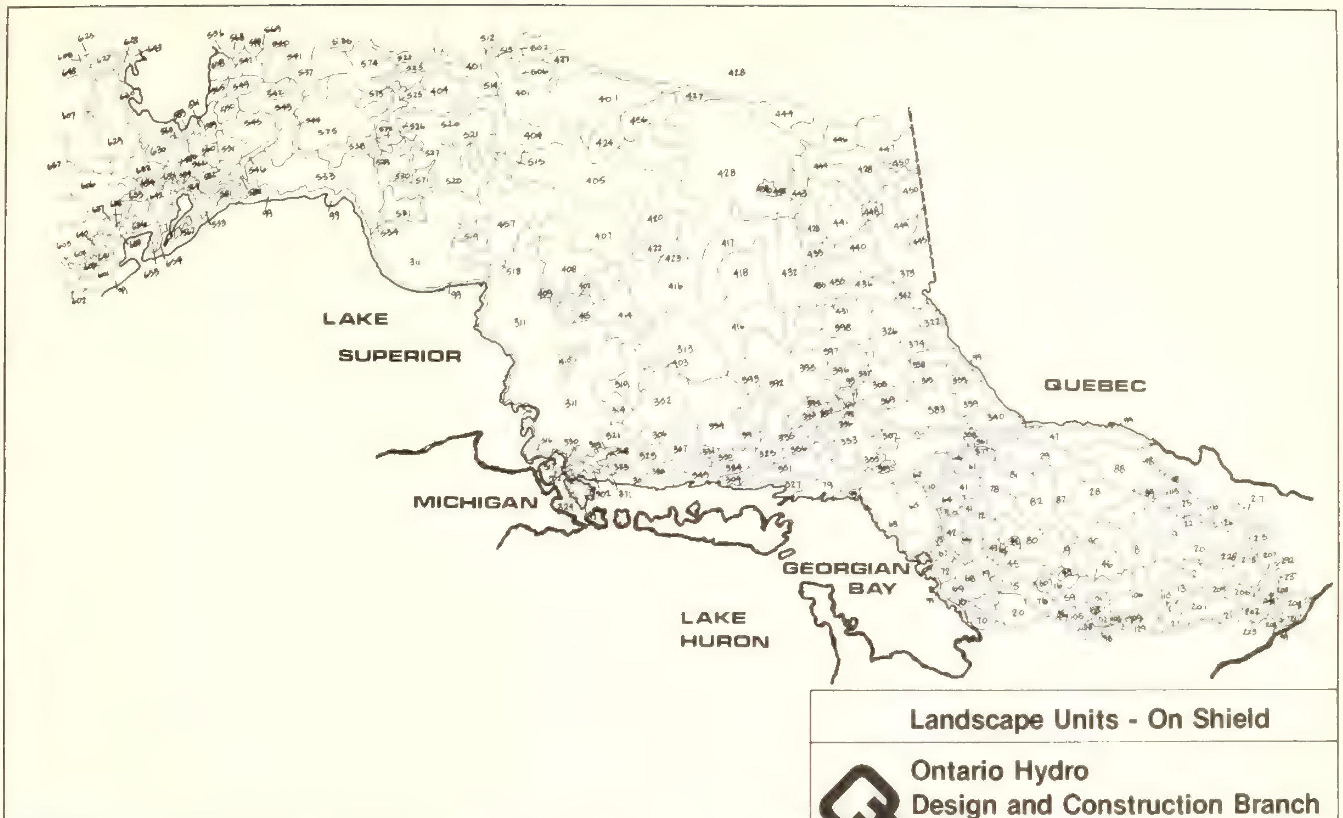

LAKE SUPERIOR
MICHIGAN
GEORGIAN BAY
LAKE HURON
QUEBEC
Landscape Units - On Shield
Ontario Hydro
Design and Construction Branch
Route and Site Selection Division

Figure 1 - Landscape Types on the Canadian Shield

Data Type: LD - Landscape Type - on shield

Area: the measurement given based on the number of cells that are encoded #514. In the Hydro data base, each cell represents 4 sq. km. Area = # of cells x 4

Landscape Element

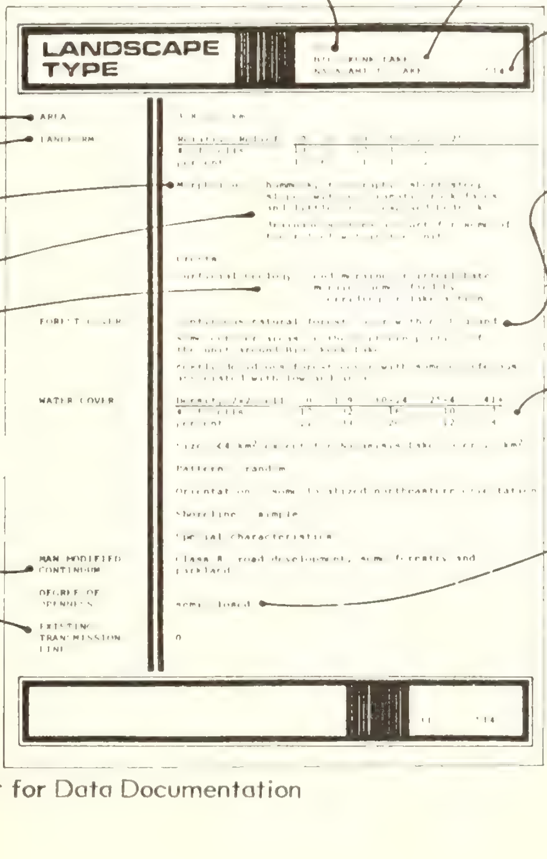
Landscape Component

Physical forms of the land that can be seen

Another 'clue' to the character of the Landscape Type

Existing visual alteration of the landscape scaled from #1 (Urban) to #9 (Wilderness)

This element gives an estimation of the amount of impact existing within a Landscape Type.


LANDSCAPE TYPE
AREA
LANDFORM
FOREST COVER
WATER COVER
MAN MODIFIED CONTINUUM
DEGREE OF OPENNESS
EXISTING TRANSMISSION LINE

Name: chosen from the actual area mapped.

Data Character: 514 - this landscape type is encoded in the computer as the number 514. Each landscape type has a unique number.

Information collected in two separate forms; 1) identify and describe the patterns and/or 2) categorize into amount of forest cover for a given unit of area (the 2 km x 2 km computer grid cell).

Information collected in two separate forms; 1) percentage of water area for each 2 km x 2 km grid cell and/or 2) categorized into patterns.

Probable visibility of a new transmission tower in the landscape type (distance viewer is able to see 'into' the landscape)

open: 2½ km
semi-open: 1½ - 2½ km
semi-closed: ½ - 1½ km
closed: ½ km

Figure 2 - Standardized Format for Data Documentation

Morphology--is related to the physical form of the landscape that can be seen. In order to achieve some degree of standardization a morphological classification was adopted. The dominant types of landforms that exist in the province include flat, flat with rock-island outcroppings, gently rolling, flat with rock ridges, hummocky, rolling and hilly.

Physiographic features--were identified within each Landscape Type to provide another "clue" as to their visual character. Some of these features found in Ontario include: clay plain, drumlin, escarpment, esker, kame moraine, limestone plain.

Forest Cover Patterns--were identified which cover existing situations throughout the province. Some examples are: checkerboard woodlots, continuous natural forest, continuous woodlots, hedge-rows, isolated woodlots, random bush.

Water Cover--characteristics of pattern, size, orientation and shoreline types were inventoried for two purposes. First, they indicate the contribution of existing lakes to the definition of landscape character and second, they assist in predicting the probability of impacting water bodies. Lakes are classified as either an isolated, integrated, or linear pattern, less than 4 square km, 4-to-16 square km or greater than 16 square km in size. Orientation is a general expression of the alignment of the majority of lakes to one of the major compass points. Shoreline types are either simple, irregular or complex.

Man-modified continuum--inventories the degree of man's alteration of the visual landscape. A comparative nine-point scale was developed which extends as a continuum from the unaltered natural landscape to the totally man-altered urban centers. The conceptual framework behind this landscape element was to provide a basis for identifying Landscape Types which have the greatest potential for or problems of "fit." For Ontario Hydro's purposes, "fit" may be described as the ability of transmission facilities to appear in harmony with various landscapes in the province.

Openness--inventories the degree to which a viewer is able to see into a landscape unit. To promote consistency of application, numerical values were assigned each openness category as follows: Open - greater than 2½kms.; Semi-open - ½-to-2½kms.; Semi-closed - ½-to-1½kms; and Closed - less than ½km.

Existing Transmission Lines--is an inventory of the number of existing transmission rights-of-way and the areal extent of their visual sphere of influence through each Landscape Type.

EVALUATION/ANALYSIS OF LANDSCAPE TYPES

The criteria used for evaluating to what degree the Landscape Types are affected by the introduction of a transmission facility evolved around specific characteristics of those Landscape Types. The evaluation focuses on what response there would be to a change in those characteristics. The characteristics are:

- visibility in the landscape type
- spatial definition of the landscape type
- color of the landscape type
- naturalness of the landscape type
- complexity of the landscape type
- uniqueness of the landscape type
- historical significance of the landscape type
- preference for the landscape type.

These characteristics cannot all be quantitatively described, but can be demonstrated by various graphics and descriptive techniques to provide the planner, public, special interest groups or any other decision-maker with a rationale for 'why' a specific Landscape Type should be avoided.

Visibility in the Landscape Type

The degree of openness of a landscape type dictates the visibility of the transmission line. The capacity of a Landscape Type to screen a transmission line is a function of the amount of forest cover, relative relief and water cover. Experience in Ontario has shown that flat, forested landscapes with few lakes provide the best potential for screening a transmission line.

Spatial Definition of Landscape Type

A transmission facility can dominate the spatial characterisitics of a Landscape Type. Spatial definition is a function of space defining objects and features such as landform, vegetation and builtform. Landscapes characterized by small intimate spaces, e.g., terminal morraine landscapes, can be severely impacted by major transmission lines.

Color of the Landscape Type

The color of the right-of-way can contrast dramatically with the surrounding landscape. Since the vegetation in the right-of-way is consistantly managed to a specific height or type, its color in both summer and winter can be very different from the landscape adjacent to the right-of-way. This is particularly true in coniferous forested landscapes where the leaf color of early successional speci in maintained rights-of-way contrasts with the coniferous forest color and winter snow contrast dramatically with the green forests surrounding the right-of-way.

Naturalness of the Landscape Type

A transmission facility is closely associated with an industrial image. Its structural design reflects man-made built forms and contrasts dramatically with visual images of natural, pristine landscapes. The visual character of wilderness landscapes or landscapes in a near-natural state can be severely impacted by a major transmission facility.

Complexity of the Landscape Type

Transmission lines tend to be a simplistic built form. Their alignment is as near a straight line as possible. They are structurally homogeneous. They are continuous for long distances and visually monotonous. When located in complex landscapes with variable relief, variable vegetation types and patterns and variable land uses, a feature as simplistic and overwhelming as a transmission line contrasts dramatically with the surrounding landscape.

Uniqueness of the Landscape Type

It is assumed that a transmission line located in a unique landscape will be more easily perceived because of the viewers increased awareness of his surroundings. Landscapes which are dominated by lakes, special landforms, unique vegetation are examples of those types.

Historical Significance of the Landscape Types

Some Landscape Types have intentionally or unintentionally been preserved as remnants of cultural heritage. They visually reflect a period in history by the character of the buildings they hold, by the character of the lot and road pattern, and by the woodlot and hedge pattern. Transmission facilities impose an image of the industrialized 20th century and contrast dramatically with historical images. The potential viewer is likely to be aware of and sensitive to the visual intrusion of a transmission facility in this landscape.

Preference for the Landscape Type

Certain Landscape Types contain features or have characteristics which have traditionally attracted people. Water has always been an attraction. Landscapes dominated by lakes and rugged coastlines have long been a visual stimulus to people. Mountainous landscapes, landscapes which change dramatically with season and which have unusual or everchanging climatic situations have always attracted people. A transmission line located in these areas will likely affect the viewer's perception and long standing preference for such Landscape Types.

This visual analysis method utilizes the visual typology described in the previous section, to determine which characterisitics in terms of complexity, spatial definition, etc. are most prevalent in each Landscape Type. The landscapes exhibiting the strongest characteristics are to be avoided where possible by transmission facilities. The weighting system, which determines the importance of the changes to the visual character of various types, is a combined attitudinal/value and best professional judgment analysis made through the use of a public Citizen's Committee and Transmission Route Planning Staff. The following section briefly describes the Transmission Route Planning Process.

THE PLANNING PROCESS

The Ontario Hydro Transmission Route Planning Process[8] which determines the location and types of facilities in the landscape, entails a stepwise elimination of possible alternatives. At the initial phase, the entire study area is examined to determine continuous pathways or bands for a transmission facility which attempts to avoid areas of economic and environmental concern. These bands are then evaluated and compared and some alternatives are eliminated from further consideration. In a subsequent route selection phase, the remaining bands are studied in greater detail to identify specific routes and sites.

A current project, the East-West Interconnection Study (Miller 1978) illustrates the sequence of steps (Figure 3) used in recommending bands for further study. The following is a brief description of each of these steps illustrating the incorporation of Landscape Types into this planning process.

Data Inventory and Storage

Environmental data, collected from a variety of sources and mapped at a scale of 1:250,000, are inputted into Ontario Hydro's computer system.

Environment Divided Into Factors

Members of a public Citizens Committee are divided into Factor[9] Working Groups to discuss specific environmental objectives[10] best related to their expertise and interest.

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[8] Vaughn, A. V. 1977. A Planning Alternative-The "Situation" Approach. Ontario Hydro, Toronto, Ontario. Unpublished document. 52 p.

[9] A major resource heading (e.g., Agricultural Production, Recreation, Visual, Wildlife, etc).

[10] A two-part statement consisting of: (i) a directive to "avoid" a particular environmental situation characterized by specific descriptive information contained within the data inventory, and (ii) an appended "because" clause outlining reasons why a situation should be avoided, in terms of the changes which could be expected if transmission facilities were located there and the perceived significance of those changes.

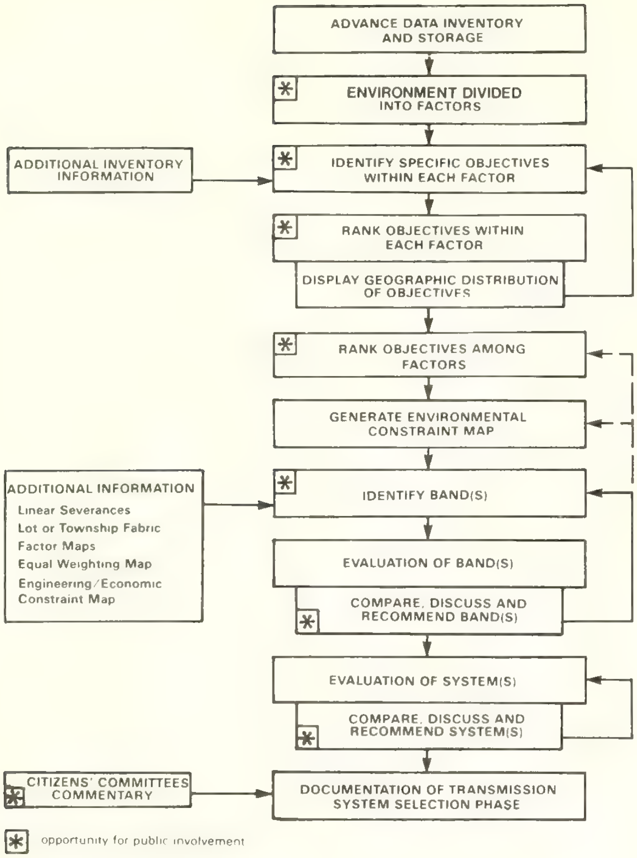

ADVANCE DATA INVENTORY AND STORAGE
ENVIRONMENT DIVIDED INTO FACTORS
ADDITIONAL INVENTORY INFORMATION
IDENTIFY SPECIFIC OBJECTIVES WITHIN EACH FACTOR
RANK OBJECTIVES WITHIN EACH FACTOR
DISPLAY GEOGRAPHIC DISTRIBUTION OF OBJECTIVES
RANK OBJECTIVES AMONG FACTORS
GENERATE ENVIRONMENTAL CONSTRAINT MAP
ADDITIONAL INFORMATION
Linear Severances
Lot or Township Fabric
Factor Maps
Equal Weighting Map
Engineering/Economic Constraint Map
IDENTIFY BAND(S)
EVALUATION OF BAND(S)
COMPARE, DISCUSS AND RECOMMEND BAND(S)
EVALUATION OF SYSTEM(S)
COMPARE, DISCUSS AND RECOMMEND SYSTEM(S)
CITIZENS' COMMITTEES COMMENTARY
DOCUMENTATION OF TRANSMISSION SYSTEM SELECTION PHASE
✱ opportunity for public involvement

Figure 3 - Transmission System Selection Process

Identify Specific Objectives within Each Factor

Specific environmental objectives are identified and developed with respect to each factor of concern with the help of the Factor Working Groups. The geographical context used by the Visual Factor is the Landscape Types. The visual analysis method utilizes the visual typology discussed in the previous section to determine which characteristics in terms of complexity, spatial definition, etc. the most prevalent in each landscape type. The landscapes exhibiting the strongest characteristics are separated out as situations to be avoided by the transmission line.

Rank Objectives within Each Factor

The objectives within each individual factor are ranked in order to their relative priority by the members of each Factor Working Group. The ranking, a collective judgment by the group, reflects the relative importance of avoiding each environmental situation and is determined by considering the potential changes and significance of those changes to both the human and natural environment. The following example demonstrates the end product of a Factor Working Groups importance ranking of visual resources within the Visual Factor.

EXAMPLE: EAST/WEST TIE STUDY

First Ranked--Avoid viewsheds of the shorelines of Lake Superior, Lake Nipigon and the North Channel.

Second Ranked--Avoid landscapes characterized by high relief (greater than 400 ft.); see Figure 4.

Third Ranked--Avoid landscapes dominated by water; with more than 40 pct. water cover.

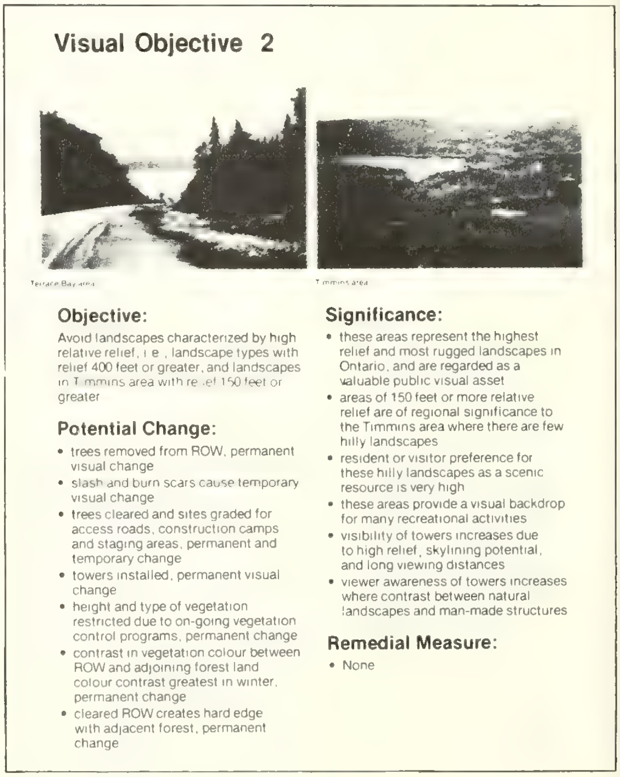
Fourth Ranked--Avoid major "U" and "V" shaped valleys, gorges and scenic waterfalls.

Fifth Ranked--Avoid areas designated as an "edge

Sixth Ranked--Avoid landscapes moderately dominated by water; 20-to-40 pct. water cover.

Rank Objectives Among Factors

It is not possible to locate transmission facilities which avoid all identified significant environmental concerns. Therefore, it is necessary to establish a basis for making "trade-offs." A listing of all objectives in rank order provides the required guidance for any routing decision. Figure 5 illustrates this ranking process.



Visual Objective 2

Terrace Bay area

Timmins area

Objective:

Avoid landscapes characterized by high relative relief, i.e., landscape types with relief 400 feet or greater, and landscapes in Timmins area with relief 150 feet or greater

Potential Change:

- trees removed from ROW, permanent visual change
- slash and burn scars cause temporary visual change
- trees cleared and sites graded for access roads, construction camps and staging areas, permanent and temporary change
- towers installed, permanent visual change
- height and type of vegetation restricted due to on-going vegetation control programs, permanent change
- contrast in vegetation colour between ROW and adjoining forest land colour contrast greatest in winter, permanent change
- cleared ROW creates hard edge with adjacent forest, permanent change

Significance:

- these areas represent the highest relief and most rugged landscapes in Ontario, and are regarded as a valuable public visual asset
- areas of 150 feet or more relative relief are of regional significance to the Timmins area where there are few hilly landscapes
- resident or visitor preference for these hilly landscapes as a scenic resource is very high
- these areas provide a visual backdrop for many recreational activities
- visibility of towers increases due to high relief, skylining potential, and long viewing distances
- viewer awareness of towers increases where contrast between natural landscapes and man-made structures

Remedial Measure:

- None

Figure 4 - Typical Objective Card

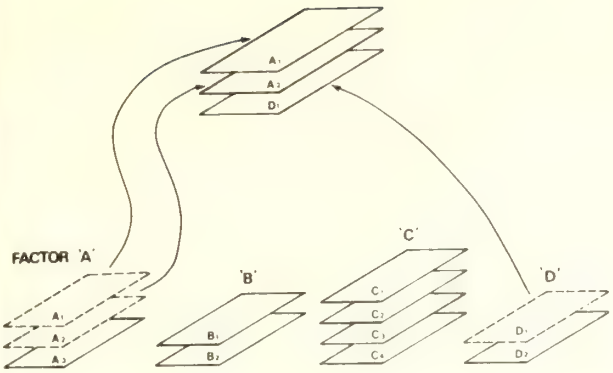


Figure 5 - Objective Ranking Process

Each major factor - or deck of cards - is ordered so that the highest priority objective is at the top of each factor - or deck. The decks are then presented to the citizen committee members, who are asked to discuss, compare and select the top card having the highest priority. This card is then removed from its deck and the next card in that deck is displayed. The process of review, comparison and selection is repeated. (In this second round, the committee members are examining the second card in one of the decks and re-examining the top cards in all the other decks.) This process is repeated until all the cards - or objectives - are ranked in order of their overall priority.

Produce an Environmental Constraintment Map

After completion of the ranking process, the computer is used to search and identify the highest rank objective for each 2 km x 2 km cell in the study area. This information is then depicted on a Constraint Map.

Identify Bands

Bands or pathways which avoid areas of greatest constraint are delineated to accommodate the system alternatives.

Evaluate and Compare Bands

Probable environmental implications expressed in terms of length of right-of-way, area of each band, width of right-of-way and environmental situations impacted are tabulated for each of the bands. Bands likely to have the best combination of least total environmental effect and maximum avoidance of the highest ranked situations are selected for more detailed routing studies.

CONCLUSION

The Visual Landscape Type Classification method of Ontario Hydro places a major emphasis on understanding the visual relationship between a transmission facility and the character of each Landscape Type in which a proposed installation might be located. An understanding of this relationship provides the basis for the development of location and design criteria which minimize overall visual impact.

A method has been developed which systematically inventories the elements which constitute landscape character. The inventory process relies heavily on key measurable data, i.e., relative relief, forest and water cover, to identify each visual type. In addition, non-parametric data are collected for each type in a consistent manner. The quantitative data and descriptive information are combined to identify and describe each Landscape Type.

Opportunities for continuous and constructive public participation is provided in the planning process throughout the lifetime of a study. A Citizens Committee is established in a study area to gain public acceptance of the study method and the contents of the data base, to identify regional concerns and to establish an overall ranking of those concerns.

In conclusion, Ontario Hydro's visual analysis process consists of three phases:

- •inventory of the visual landscape
- •assessment of the visual resources (including public preferences)
- •integration into a holistic planning process.

This method has been effectively applied in four Regional Siting Studies and is currently being utilized in a major study in Northern Ontario. Ontario Hydro planners have found this method appropriate at the level of decision-making necessary for the delineation of broad band corridors.

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Appropriate Combinations of Technology for Solving Landscape Management Problems—
Session J: Timber Management

Scenic Beauty Estimation Model: Predicting Perceived Beauty of Forest Landscapes[1]

Terry C. Daniel and Herbert Schroeder[2]

Abstract: An important activity in any land-use planning process is prediction of the consequences of alternative management approaches. Alternative plans must be compared in terms of their respective costs (economic and environmental) and benefits (in market and non-market values) if rational choice among them is to be made. The purpose of this paper is to describe a model for quantitatively predicting the effects of alternative vegetation management programs on landscape scenic beauty. Scenic beauty is assessed in terms of quantitative indices based upon public aesthetic judgments. Predictor variables are forest characteristics normally inventoried in the process of land use planning or timber sale administration. The primary goal of the Scenic Beauty Estimation Model is to provide quantitative predictions to facilitate the evaluation of tradeoffs between scenic beauty and other objectives of forest management.

INTRODUCTION

An essential element in any land-use planning process is the simulation (prediction) of the consequences of alternative management approaches. Alternative plans must be compared in terms of their respective costs (economic and environmental) and benefits (in market and non-market values). A rational decision can then be made as to which alternative should be pursued. In this context quantitative simulation models are being developed to improve managers' ability to determine the effects of contemplated actions. For example, the effects of implementing different harvest methods may be simulated to predict subsequent water production and quality, erosion, future tree growth and other factors.

The purpose of this paper is to describe the development and testing of a model for predicting the effects of alternative vegetation management programs on landscape scenic beauty. Scenic beauty is assessed in terms of quantitative indices based upon public aesthetic judgments. Independent (predictor) variables were selected from among a set of forest characteristics that are normally inventoried in the process of developing a land use plan or preparing a timber sale or other management action. These same variables frequently serve as predictor (input) and/or product (output) variables in other simulation models now being used or developed. The primary goal of the Scenic Beauty Estimation Model is to provide valid and useful predictions of the scenic consequences of alternative actions--quantitative predictions that will facilitate the evaluation of tradeoffs between scenic beauty and other objectives of forest management.

SBE METHOD

The prediction model presented in this paper has been developed in the context of a more general landscape assessment methodology. Development of the Scenic Beauty Estimation (SBE) Method has been ongoing since 1972. The SBE Method is a system for quantitatively indexing the aesthetic quality of landscapes.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979. The research reported was supported in part by the Rocky Mountain Forest and Range Experiment Station, USDA Forest Service, Ft. Collins, Colorado.

[2] Associate Professor of Psychology and Renewable Natural Resources; and graduate student, University of Arizona, Tucson, Arizona 85721.

Interval scale measures of scenic beauty are derived from the aesthetic perceptions and judgments of selected human observer panels. Panels may represent the "general public," or they may be selected from specific populations such as landscape managers, special interest or user groups, or experts of various kinds. In any event, it is the human observers' perception and judgment of the aesthetic qualities of the landscape (or simulations thereof) that determine the index, the "Scenic Beauty Estimate (SBE)," assigned to that landscape.

Implementing the SBE Method

The most frequent applications of the SBE Method have involved the use of color-slide simulations of forested landscapes. Typically 15 to 30 color-slides are taken within each landscape area that is to be assessed. In order to reduce any bias that the photographer might introduce in the representation of the landscape, photos are taken according to a predetermined stratified random sampling procedure. Slides from a number of different areas are then presented to selected observer panels. Each observer independently judges the scenic beauty of the area represented by each color slide.

Judgments are usually reported (and recorded) in terms of a 10-point rating scale, where a 1 indicates a judgment of "very low scenic beauty" and a 10 "very high scenic beauty." The simple rating responses can be useful indicators of landscape scenic beauty in many situations. Frequently individual ratings (or mean ratings) can be used in statistical analyses (such as correlation/regression or various hypothesis-test statistics) aimed at determining similarities and differences among landscapes and/or observers. Because there is no assurance that different observers will use the rating scale in the same way--that one observer's "6" indicates the same perception of scenic beauty that another observer's "6" does--the ratings should not be treated as a direct or absolute indicator of scenic beauty. Ratings (and mean ratings) are influenced by idiosyncracies of individual observer's use of the rating scale such as individual standards for assigning high, medium or low ratings. Also, a number of arbitrary procedural features, such as the number of points (categories) in the rating scale and the number and type of landscapes judged in a session, will affect the rating scores obtained for a given landscape and the magnitude of any difference in ratings for different landscapes.

In such situations it is common practice in psychological assessment (and other measurement methods) for the "raw responses" to be transformed according to some scaling model. The resulting standardized values (typically adjusted to have a common defined origin or zero point and a standard unit of measure) may be more directly compared across observers, rating scales and other procedural variations. Equally important, the scaling model makes the assumptions that are involved in the interpretation of the resulting indices more explicit.

The scaling model that underlies the SBE Method has been articulated in Daniel and Boster (1976). The model is a Thurstone (1927) type scaling model modified to reflect concepts from the Theory of Signal Detectability (Green and Swetts 1966, Swetts 1973), a more contemporary, but closely related perceptual judgment model. Similar scaling models have been applied in many contexts, ranging from the evaluation of food items and other consumer goods to measuring the quality of television pictures. The application of the SBE model to measure landscape scenic quality is a straightforward extension of well tried psychological assessment concepts. The resulting Scenic Beauty Estimates or "SBEs" are standardized relative indices of perceived scenic beauty that may be directly compared in spite of differences in observers and procedures. The "meaning" of the SBE index is explicitly determined by the features of the scaling model and the associated procedures specified for obtaining the index.

The SBE Method has primarily been developed and tested in the context of forest scenic beauty assessment. Procedures and computation models have primarily been articulated for cases in which independent observers assign ratings to landscapes or landscape simulations. A large number of variations in procedures and some modifications of scaling computations are, however, consistent with the basic model. Certainly many different types of simulation or landscape sampling methods may be (and have been) used, including sketches, photomontages, verbal descriptions and direct on-site observation. Landscape dimensions other than scenic beauty (e.g., recreation value, naturalness, or attractiveness as a summer home site) may be assessed with very minor changes in the method. Changes in the number of categories in the rating scale are readily accommodated. With some changes in the scaling model, forced-choice (e.g., paired-comparison as in Buhyoff et al.) or rank ordering procedures may be substituted for the rating scale. With appropriate models, assessments based on ratings, rankings, or choices may all produce the same scale value or index for a given landscape. The basic SBE procedures have proven very versatile and effective (e.g., Daniel et al. 1977, Schroeder & Daniel in press). Alternative procedures can be adopted, however, depending upon the requirements of particular landscape assessment problems.

Testing the SBE Method

Over the past seven years the SBE Method has been subjected to a number of tests and has undergone several modifications and extensions. Initial efforts were primarily directed at ascertaining the sensitivity and reliability of the method, as these are two properties that are fundamental to any measurement system (Daniel 1976). SBE values do distinguish between different landscapes; sites differing in vegetation and other characteristics consistently yield different SBE's. Further, measures of the same landscape on different occasions (with the same or a comparable panel of observers) will produce equivalent SBE indices (Daniel & Boster 1976). The method has, then, proven sensitive--landscapes differing in (presumably) relevant characteristics yield different SBE's --and reliable--the same landscape yields the same SBE on repeated applications of the measurement system.

Validity is another essential criterion for a measurement system. This property of a measurement method is not, for the most part, subject to direct empirical test. Tests have shown that SBE's based on random color-slide simulations are equivalent to indices obtained when observers' judgments are actually made onsite in the landscapes (Daniel et al. 1973, Daniel & Boster 1976). This confirms the validity of using color slides to represent the landscapes for which assessments were obtained, but it may be that neither slide-based nor onsite judgments reflect the "true" scenic beauty of the landscapes. Several tests have shown close correspondence between SBE's and ranking or paired-comparisons of the same landscapes, and SBE's have been found to correlate strongly with expert judgments of scenic quality (Shoemaker in press). All of these findings are positive indications of the validity of the SBE Method, but none is completely conclusive.

Determining in general whether a method "measures what it is supposed to measure" is largely a theoretical (or even philosophical problem, especially when the property being measured is as poorly understood as "beauty" or "aesthetic quality"). In many respects, the procedures (or operations) employed by a measurement system imply a definition of the property that is being measured.

The SBE Method clearly implies that scenic beauty is fundamentally subjective--beauty is not inherent in a landscape, but depends upon human perceptions and judgments of that landscape. This does not, however, imply that the physical properties of the landscape are unimportant, that beauty is entirely "in the eye of the beholder." Indications are that identifiable properties of the landscape produce consistent perceptions within and between observers and that different observers assign very similar aesthetic judgments based upon these perceptions (Daniel & Boster 1976, Shafer et al. 1969). In the SBE Method it is the perceptual judgments of people that establish the scenic beauty of a landscape. However, people's judgments have been found to be strongly and consistently affected by characteristics of the judged landscape. It is this relationship between perceptual judgments and landscape features that forms the basis of the Scenic Beauty Prediction Model.

SCENIC BEAUTY PREDICTION MODEL

Preliminary Efforts

An initial attempt to relate SBE's to the features of the landscape was reported in Daniel and Boster (1976). For this study large numbers of color slides of ponderosa pine forest scenes were inspected in an effort to determine those features that were associated with high or low scenic beauty indices. Intuitively features such as "openness," "visual depth," and "greenness" seemed likely candidates for scenically relevant characteristics. Features such as the size and density of trees, the amount and arrangement (piled or scattered) of downed wood and slash, and the covering (or lack thereof) of the forest floor also appeared to be important. These and a number of other factors such as clouds, stumps, rocks, and slope of the land were included in a systematic study to determine their relationship to scenic beauty judgments.

Measures of the selected landscape features were obtained for 30 scenes by having a panel of five judges rate each scene for each feature. All features were defined as dimensions and judgments for each dimension were recorded in terms of a 6-point scale. For example:

Openness: 1 (very closed in, can't see very far) to
6 (very open, almost unlimited views)

Average tree size: 1 (very small, a few inches in diameter) to
6 (very large, tall, mature trees of large diameter).

Ground cover: 1 (very sparse, mostly bare earth and rocks) to
6 (very lush, thick grass and other plants).

The judges had no formal training in forestry or landscape architecture (in fact the five judges were a psychologist, an economist, and three psychology graduate students). Nonetheless, after some initial practice and discussion, a high degree of consistency was achieved in the forest feature ratings that were assigned (independently) to the slides of forest scenes.

When the ratings for each feature-dimension were correlated with the SBE's for the assessed forest scenes, some very strong relationships were found. The amount of downed-wood, for example, showed a very strong negative association with scenic beauty; the more downed wood, the lower the scenic beauty. Other features, such as openness and tree size had strong positive relationships with perceived scenic beauty. Many interrelationships were observed among the landscape features as well. Scenes with larger trees tended to be more open, for example (Daniel & Boster 1976).

In spite of its many shortcomings, this preliminary study offered substantial encouragement for further efforts to determine the effects of landscape features on perceived scenic beauty. Inspection of the interrelationships among the various features studied suggested that the number of forest characteristics could be reduced with little or no loss in the relationship to the SBE's. Further, it seemed possible to delete many feature-dimensions that had only indirect implications for forest management, such as "openness," in favor of more directly manageable landscape features, such as average tree size. Subsequent work then focused upon determining a predictive relationship between manageable landscape features and public perceptions of scenic beauty.

A Slide-Based Model

A concerted effort to develop a predictive model relating manageable forest features to perceptions of scenic beauty was undertaken by Louise Arthur in her doctoral dissertation. The central aspects of this work were reported in Arthur (1977). As with the preliminary study described above, measures of landscape features (in the principal study) were based on inspection of color-slide representations. In Arthur's study, however, two experienced foresters independently inspected each scene and estimated values for a number of typical forest inventory factors, such as trees per acre in various size classes, volumes of downed wood, and grass and herbage volumes. These and several similar variables were combined into a linear regression equation that successfully predicted (over 80% of variance accounted for) the perceived scenic beauty (SBE's) of the scenes for general public panels.

The model was very effective in predicting the scenic beauty judgments of public observer panels. However, the landscape features were gauged by inspection of photographs, the same photographs that observers judged. Such a procedure is not very representative of how such a model would actually be used to predict the effects of contemplated forest management actions. Landscape characteristics would generally be assessed directly in the field with less than perfect correspondence to scenes that might be observed by visitors. Thus, the next step in the development of a practical scenic beauty prediction model would require that landscape features be assessed by field inventory methods that are in use by forest managers.

Coconino National Forest Model

A recently completed study extended the previous efforts to develop a valid and useful model for predicting perceived scenic beauty of forest landscapes. In this study, forest features were assessed by direct in-the-field inventories of overstory, understory, ground cover and downed wood characteristics of forest sites. Color slides, coordinated with these inventories, were shown to panels of observers to obtain SBE values for each site. The relationship between the physical forest features and the SBE values was then determined and served as the basis for a Scenic Beauty Prediction model.

Photographic and physical data were collected on square plots approximately one acre in area (212 feet on a side). The locations of the plots were selected with the objective of representing a wide range of physical and aesthetic conditions occurring in the ponderosa pine zone of the Coconino National Forest, Arizona. Through discussions with Forest Service personnel familiar with the forest several forest types and geographic regions were delineated. These included some areas bordering on mixed conifer and pinyon-juniper forests, and some areas representing the extremes of aesthetic and physical conditions.

At each sample location, a center point was established and a random compass heading was used to determine the orientation of the diagonals of a square sample plot. Four photographs were taken from the center of the plot, each oriented along one of the plot diagonals. Four additional photographs were taken one from each of the plot corners oriented toward the center point.

After the photographs were taken, timber, downed wood and vegetative ground cover were inventoried at the site, with the assistance of forest technicians. Eight measurements of each physical variable were made on each plot, with each measurement corresponding to one of the eight photographs. The sampling scheme is graphically illustrated in Figure 1.

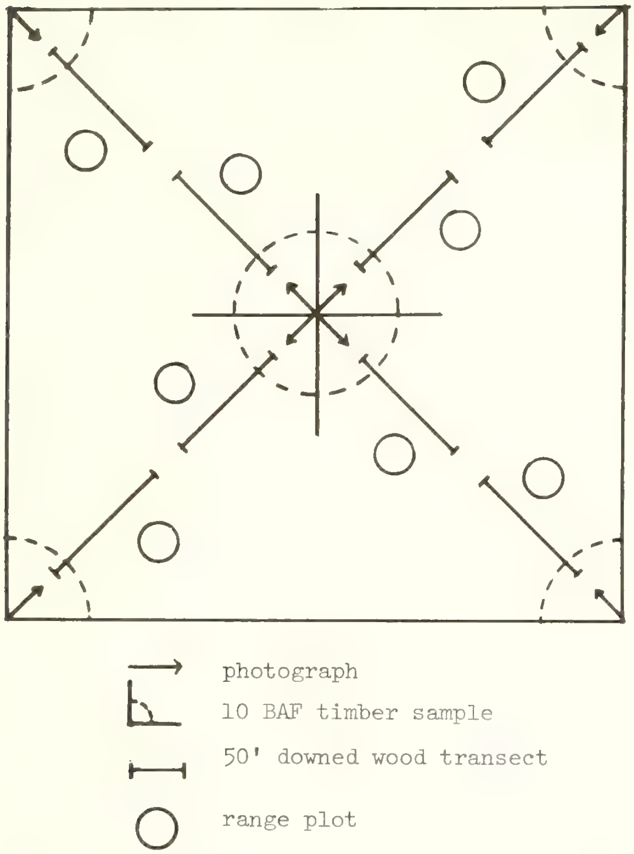

Figure 1 --Schematic of sampling procedure. Each plot was one acre in size, and plot orientation was randomly determined for each plot.

Forest Inventory.--Trees greater than five inches in diameter were inventoried (in 4-inch diameter classes) using a prism with a basal area factor of ten. A complete 360° sample was taken around the center point. This sample was subdivided into four 90° quadrants corresponding to the directions in which the photos were taken. At each corner point another sample was taken covering the 90° quadrant directed toward the interior of the plot. Seedlings and saplings were counted in 150-foot-long strips lying along the diagonals of the plot. The strips were five feet wide for seedlings, and ten feet wide for saplings.

Downed wood was inventoried using the method of Brown (1974). Two fifty-foot sample transects were placed on each line joining the center to a corner of the plot. The numbers of pieces of downed wood intersecting the line were tallied according to size. The species composition of the downed wood and a judgment about whether it was predominately natural or man-caused (slash) were also recorded Vegetative ground cover was inventoried by placing two small circular plots (9.6 ft^2 area) adjacent to each diagonal of the sample plot. The dry weight in grams of each species occurring within the circular plot was estimated. From the eight ground cover plots one was randomly selected and all of the plants in that plot were clipped. These were later dried and weighed species by species. The actual weight thus obtained was used to correct for any constant bias in the field estimation.

Scenic Beauty Judgments.--Ninety plots were inventoried between June 7 and July 15, 1977. The eight color slides from each plot were shown to groups of observers, who rated scenic beauty on a 10-point scale. The ratings were analyzed to derive independent SBE's for each scene.

Regression Models.--Two estimates of the physical and aesthetic characteristics of each of the 90 plots were made, one by averaging the four observations obtained at the center of the plot, and the other by averaging the observations obtained at the corners. Thus 180 cases were available for regression analysis. The 180 cases were classified according to the estimated percent of the trees on the plot which were ponderosa pine. Models were then developed for different types of forests, ranging from predominately ponderosa pine to more diverse mixtures of species.

Stepwise linear regression analyses were performed separately on cases with 90% or more ponderosa pine (64 cases), 50% of more ponderosa pine (87 cases), 30% or more ponderosa pine (113 cases), and finally on all 180 cases regardless of species composition. Scenic beauty was the dependent variable in all analyses. The multiple R's were all reasonably high accounting for from 65% to 73% of the variance in SBE's.

The best predictions resulted when the model was restricted to plots with 90% or more ponderosa pine. Overall, the best predictors seemed to be those relating to vegetative ground cover (grass and forbs) and the character of downed wood (natural or slash). The actual volume of downed wood appeared not to be a very powerful predictor, but in fact, areas in which slash predominated over natural downed wood also tended to have large total volumes of downed wood. The fact that the character of the downed wood entered the equation before the downed wood volume variables may indicate that there are negative aesthetic effects of man-caused slash which are relatively independent of the volume of material (for example piles or windrows, stumps and other visible evidence of cutting).

The initial models are very successful from a statistical point of view, but they present several problems for actual application. The large number of different predictors used, each requiring rather detailed data, results in a complex and somewhat unwieldy model. Also, the individual predictors are correlated among themselves, which makes interpretation difficult. A predictor may appear to have a small effect on predicted SBE's either because it is unrelated to scenic beauty, or because it is highly correlated with another variable which is a good predictor (as with downed wood volume and the slash variable). In the latter case, although the variable makes a statistically nonsignificant contribution to the prediction equation, in reality it may be an important factor affecting scenic values.

To obtain models more suited for practical applications, two steps were taken. First, variables which did not appear to contribute to the prediction of scenic beauty, or which would not commonly be available in forest planning applications, were deleted from the model. Second, some of the variables were combined to form a less detailed but more concise set of predictors. For example, the number of seedlings per acre (trees less than 4.5 feet high) and the number of saplings per acre (trees taller than 4.5 feet and less than 5 inches in diameter) were combined to form a single variable (PP/acre < 5" DBH). In this way a more manageable model can be derived, and the complex pattern of intercorrelations can be simplified.

A model for application to predominately ponderosa pine forests was developed using stepwise regression with the predictors shown in Table 1.

Table 1: Limited SBE Model: More than 90% Ponderosa Pine

Variable *	Mean	S.D.	B	Beta	R	Sensitivity
lbs/acre Forbs	36.48	63.93	.2016	.4268	.542	.736
PP/acre, > 16" DBH	14.63	13.62	.6006	.2708	.622	.876
cu. ft./acre Slash	547.24	594.65	-.0141	-.2774	.675	-.774
lbs/acre Shrubs	4.77	21.13	.2620	.1833	.696	.125
lbs/acre Grass	80.06	155.55	.0359	.1849	.709	.288
PP/acre, < 5" DBH	1724.77	2074.30	-.0012	-.0800	.714	-.201
PP/acre, 5-16" DBH	103.01	137.89	-.0196	-.0895	.718	-.202
Constant			-3.871			
Scenic Beauty	4.66	30.20				

$N = 64,\ F(7, 56) = 8.49,\ p < .001,\ R = .718,\ S_e = 22.31$

* Variables are listed in the order in which they entered the regression equation.

The coefficients of the regression equation (B's) depend on the units of measurement of the predictors and therefore do not directly reflect the importance of individual predictors in the equation. The Beta coefficients (standardized regression coefficients, β) are based upon the standard deviation of the predictors' distributions, and therefore are a better measure of the importance of each variable for predicting scenic beauty. A high beta for a variable indicates that the prediction equation is relatively sensitive to changes in that variable. The table also presents an alternative measure of the sensitivity of the equation to changes in the predictors. The numbers in the column labeled "sensitivity" tell how much the predicted SBE will change as a result of a 10% increase in the predictor, evaluated at the mean value of the predictor.

When applied to plots with at least 90% ponderosa pine, the model shown accounted for more than 50% of the variance in SBEs. The coefficients of all predictors are in accord with reasonable intuitive expectations of the aesthetic effects of these variables and are consistent with previous studies (Arthur 1977, Daniel & Boster 1976). Ground cover and large trees are attractive, slash has a powerful negative influence, and smaller trees appear to have a mild negative effect on scenic beauty. Although this model is statistically less powerful than the more complex models, it appears to be a more accurate representation of the causal factors underlying scenic judgments. It is certainly an easier model to apply to actual scenic beauty predictions.

When the same set of predictors which was used for the ponderosa pine model is applied to plots on which substantial numbers of other tree species occur, the predictive power of the resulting equation is considerably reduced. This is not at all surprising because the ponderosa pine model includes no variables to indicate the presence (or numbers) of other species of trees. The performance of the model on plots with a mixture of species can be improved by including variables to represent the different tree species. When the total numbers of trees other than ponderosa pine, classified by species, are entered into the regression analysis, the model once again accounts for more than 50% of the variance in SBEs. This "mixed species" model is presented in Table 2.

Table 2. Limited Mixed Species Model: All Cases

Variable	Mean	S.D.	B	Beta	R	Sensitivity
lbs/acre Forbs	91.78	164.15	.0671	.3043	.511	.616
other species/acre, < 5" DBH	1754.73	2229.19	.0054	.3295	.600	.939
PP/acre, > 16" DBH	13.01	14.62	.5696	.2301	.635	.741
other species/acre, > 16" DBH	3.14	7.07	1.1745	.2293	.674	.369
lbs/acre Grass	70.17	110.51	.0717	.2189	.706	.503
cu. ft./acre Slash	513.03	711.77	-.0102	-.2010	.732	-.525
PP/acre, 5-16" DBH	103.10	128.40	-.0341	-.1210	.741	-.352
lbs/acre Shrubs	38.31	117.65	-.0213	-.0691	.744	-.087
other species/acre, 5-16" DBH	22.36	46.02	-.0311	-.0395	.745	-.069
Scenic Beauty	22.04	36.20	Constant = .6264			

N = 180, F(9, 1970) = 23.53, p <.001, R = .745, S_e = 24.79

In general, tree species other than ponderosa pine seem to make positive contributions to scenic beauty. When other kinds of trees occur along with ponderosa pine, predictions can be improved by including even limited information about the other species. A model designed specifically for forest types other than ponderosa pine (such as mixed conifer or pinyon-juniper) would include even more detailed information and would undoubtedly produce even better results than the simple mixed species model presented here.

Model Tests.--The predictive validity of the ponderosa pine and the mixed species models was tested by withholding a random selection of cases from the data set and deriving models from the remaining cases. These models were then used to predict scenic beauty values for the withheld cases. The correlation between predicted and actual SBEs is an index of the ability of the regression equation to predict scenic beauty. For the ponderosa pine model, 15 of the 64 cases with 90% or more ponderosa pine were withheld. The correlation between actual SBE's of these 15 cases and the SBE's predicted for them by the equation derived from the remaining cases was .71. The same procedure was followed for the mixed species model. A sample of 39 cases was withheld and an equation based on the remaining 141 cases was used to predict SBEs for those cases. The correlation of predicted to actual SBE's was .55. Both models therefore have the ability to predict the scenic beauty of the withheld cases, but the predictions are much better when the analysis is restricted to plots having 90% or more ponderosa pine.

Conclusions.--Application of the models presented in this report requires that some qualifications be met. First, the range of physical conditions within which valid predictions can be made is restricted. If a linear prediction equation, such as the ones described here, is applied to areas which are very different from the ones used to develop the model, inaccurate predictions may result. It should also be realized that the predictions arising from these equations are statistical estimates, and that deviations from predicted values are to be expected. A scenic beauty prediction should be interpreted as representing a range of likely outcomes, rather than as a single, precise prediction. The amount of uncertainty in scenic beauty predictions is indicated by the standard error of estimate (S_e), presented in the tables with each model. The higher this standard error, the greater the degree of uncertainly in SBE's predicted by the model.

Another limitation of the Coconino model, of course, is that it may not apply to forest areas having substantially different features. The areas sampled for the model's development were generally rather gentle in slope and topography, and had few prominent land features. In particular, no significant water features were present in any of the sample plots. Also, human artifacts, such as roads, fences, or cabins, were purposely excluded. Future efforts will be directed at testing the range of forest conditions to which the model may be applied, and at increasing the accuracy and robustness of the model.

Many tests and refinements will be necessary before the Coconino model can be extended into a reliable, valid and useful model for predicting mixed conifer forests. Some such efforts are described in the next section of this paper. In the meantime, the model is being used on an experimental basis in the Coconino National Forest. Predictions have been made of post-treatment scenic beauty for a number of timber stands that will be subjected to harvest this summer and fall. Unfortunately, such a test of the predictive validity of the model in an operational setting requires considerable time. It will be a couple of years before the results of that test are available. Those tests which have been made do indicate (statistically) that the model can perform well in predicting scenic beauty values for landscapes similar to those used in the model's development.

FUTURE MODEL DEVELOPMENT

A study is in progress that will give some indication of the generality of the current version of the Scenic Beauty Prediction Model. About 40 sample sites in the Arapahoe/Roosevelt National Forest, Colorado, have been selected, inventoried, and photographed using procedures similar to those used on the Coconino. SBE values have been obtained for these Front Range ponderosa pine sites.

Preliminary indications from the Colorado study have been very encouraging. When the Coconino model is applied without modification to predict the scenic beauty of the Colorado sites, only mediocre results are obtained. However, if the model is calibrated by simply adjusting the coefficients (weights) for the variables in the Coconino model, good results are obtained--over 50% of the variance in scenic beauty values can be accounted for. These results are rather impressive given that the Colorado sites were much steeper in topography and were quite different in timber and vegetation characteristics.

Predictions for the Colorado Front Range sites were improved even more when additional variables were added to the predictive model. All of these sites were in an area that has been greatly affected by an infestation of mountain pine beetle. In some stands sampled, all ponderosa pine trees over a few inches in diameter were dead. When the numbers of small, medium and large categories of dead ponderosa pine trees and the number of lodgepole pines (not found in the Arizona samples) were added to the Coconino model, over 65% of the variance in SBEs was explained. The addition of these variables did affect the coefficients for the variables used in the original model, but the original variables still had essentially the same effect on scenic beauty. Large (live) ponderosa pines and lush ground covers produced positive effects on SBEs, and smaller (live) trees and larger volumes of slash produced negative effects on SBEs. Dead trees had negative effects on perceived scenic beauty.

Other studies are in progress that will help to determine the range of applicability of the Scenic Beauty Prediction Model. Additional sites in Arizona and Colorado have been, or soon will be sampled. In each case, a complete "multi-resource" physical inventory will be taken in conjunction with color-slides.

In addition to the tests of the predictive capabilities of the scenic beauty model, several studies of variations in inventory techniques will be undertaken. Downed wood and slash inventory procedures especially have been found to be time consuming and of relatively low reliability. Alternative procedures are being devised and will be tested. Good measures of downed wood and slash are important to the Scenic Beauty Prediction Model, so it is essential that reliable and efficient procedures be developed for obtaining information about this forest feature. Similar problems have been encountered with measures of vegetative ground cover, and alternative inventory methods are being explored with the assistance of forest scientists.

The model has (to date) been developed on the basis of rather intensive inventories and photo samples of small forest areas (approximately one acre). For practical applications, however, larger units and data based on less intensive samples will be typical. Therefore, efforts are being made to apply the model to operational scale areas (timber stands ranging from 10 to 150 acres) that are inventoried less intensively.

Efforts to develop further, refine, and test the Scenic Beauty Prediction Model will continue. The ultimate goal of this effort is to produce a useful tool for quantitatively predicting the perceived scenic consequences of alternative forest management actions. The focus of the model building effort, therefore, is upon manageable forest characteristics, especially vegetation characteristics that are typically considered and manipulated by forest managers. Whether this effort will finally succeed in producing a general prediction model (or family of models) that can accurately predict public perceptions of scenic beauty in many forest settings remains to be seen. Results from recent and ongoing research indicate substantial promise for the approach.

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The Semantic Differential in Landscape Research[1]

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Abstract: On-site reactions of groups of viewers to six timber harvesting procedures were measured by direct and indirect measuring techniques. Using the direct technique, groups recorded their overall impressions of harvested tracts on five-point scales ranging from very favorable to very unfavorable. For the indirect technique, semantic differential procedures were used. Factor scores developed from the evaluative factor of the semantic differential reactions were highly correlated with overall impression scores for the harvested tracts. In addition to validating the direct reactions, semantic differential data contributed to a partial explanation of why some tracts were rated more favorably than others.

INTRODUCTION

Knowledge of the public's landscape preferences is an important element in resource planning and management. Planners, managers and researchers should be cognizant of landscape preferences because many people are concerned about the long-term effects of resource manipulation, or object to the short-term appearance of certain activities such as timber harvesting.

These concerns and objections are understandable. Professional resource planners and managers have such a long-term view of resource management that their perception of timber harvest sites is considerably different from that of most casual observers. Complete recovery from timber harvests is often so slow that many people perceive the visual site degradation as permanent. Therefore planners, managers and researchers should refine the tools at their disposal or develop new tools to determine public landscape preferences.

The questions surrounding forest aesthetics research have always been troublesome. For instance, are viewer reactions based on photographs or slides as reliable as those based on actual site visitations? Should one be more concerned with the on-site results of a timber harvest? or the distant view? How valid are viewer reactions to the results of timber harvests? What assessment methods are most useful; most reliable; most efficient? Some of these questions have been answered by experts such as Craik (1972), Kaplan (1975) and Dunn (1976). But the questions of the validity of viewer reactions have not been resolved satisfactorily.

One method that has been used in the field to determine viewer responses to forest management activities is scenic beauty estimation or SBE(Daniel and Boster 1976). Using this technique, groups of viewers rated the beauty of landscapes from photos taken in random directions and at random points within the landscapes. Standardized scores were used to measure differences in perceived scenic beauty among landscapes. The scenic beauty estimation method shows promise as a direct measure of aesthetic preferences. Schweitzer et al. (1976) used SBE, claiming it is "a well-tested technique." Another technique, the semantic differential, has also been used successfully by researchers in evaluating physical environments (Winkel et al. 1969; Calvin et al. 1972; Zube et al. 1974), but their studies did not validate viewer reactions.

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The objectives of this paper are to describe how semantic differential procedures were used to corroborate viewer reactions to recently harvested northern hardwood forest stands, to suggest input variables toward a model for predicting viewer reactions to these sites and to help enrich the quality of information obtained in landscape preference studies.

In the semantic differential technique, developed and tested by Osgood _et al_. (1957), respondents use a series of bipolar adjective pairs to judge a concept. Respondents decide whether a concept, for example, mother, is associated more with warm or cold, hard or soft, etc., and to what degree:

warm ______ ______ ______ ______ ______ cold

hard ______ ______ ______ ______ ______ soft

small ______ ______ ______ ______ ______ big

rough ______ ______ ______ ______ ______ smooth

Osgood found that when semantic differential data are factor-analyzed, one factor that emerges is "an index of attitudes," or an evaluation of the concept. This index is labeled the evaluative factor. Brinton (1961) noted: "An attitude score, because of its close relationship with the evaluative factor in the semantic differential, is almost always present in the data."

Although most studies in which the semantic differential is used deal with concepts, this study explores the notion that the "concept" to be evaluated could be a forest scene.

THE STUDY

Three study sites were chosen in upstate New York. Each site was a mature northern hardwood sawtimber stand that contained over 100 square feet of basal area per acre. At each site, timber was harvested by three cutting methods: individual-tree selection (partial cutting), patch clearcutting and strip clearcutting. Each cutting method was contained within a 7-10 acre tract. Sixteen one-fifth acre patches, laid out in a series of zigzag patterns and three 70-foot wide by 300-foot long zigzag strips were harvested at each location. This meant that instead of 10-acre patch or strip clearcuts, the actual area cut was about 3.5 acres. In the partially cut tracts, each 10-acre stand was reduced from about 100 square feet of basal area per acre to approximately 70 square feet of basal area according to guidelines by Arbogast (1957) and Leak _et al_. (1969).

Within each of the three cutting methods, the visual impact of top-lopping was also studied. For this study, top-lopping was defined as cutting limbs and branches from the unused portion of a harvested tree so that no branch larger than 2 inches in diameter extended more than 4 feet above the ground. This cutting arrangement resulted in six tracts at each study location: partial cut--lopped and unlopped; patch clearcut--lopped and unlopped; strip clearcut--lopped and unlopped.

This study was part of a larger project (Nyland _et al_. 1976) that investigated the effects of logging on soils, wildlife, woody vegetation, logging efficiency and forest aesthetics--how groups of viewers reacted to different logging procedures. The logging operations were all completed by the fall of 1973; by the fall of 1974, eight groups of viewers had evaluated the tracts. Representing seven organizations, the groups ranged from 6 to 38 people. Each group visited one location and evaluated all six tracts in that area.

The number of respondents and their interests varied at each location. Tracts near Camden, N. Y., were visited by 22 people in two groups--members of the Camden Rotary Club and members of the Onondaga County Audubon Society. Tracts near Cuyler, N.Y., were visited by 35 people in three groups--members of a hiking organization, members of a student forestry club and a nature interpretation class. Tracts near Northville, N. Y., were visited by 86 respondents, two groups of students from a forestry summer camp and members of the Fulton County Conservation Education Advisory Committee.

Upon arriving at a study location, each respondent was given a Timber Removal Evaluation Packet that contained a two-page questionnaire for each tract. Instructions for evaluating the tracts were read. Questions about research design or whose answers might have biased study results were postponed until all six tracts had been evaluated. Each group spent about 7 minutes in a tract before completing the appropriate tract's questionnaire (fig. 1). To avoid sequential bias, groups were guided through the tracts in differing sequences.

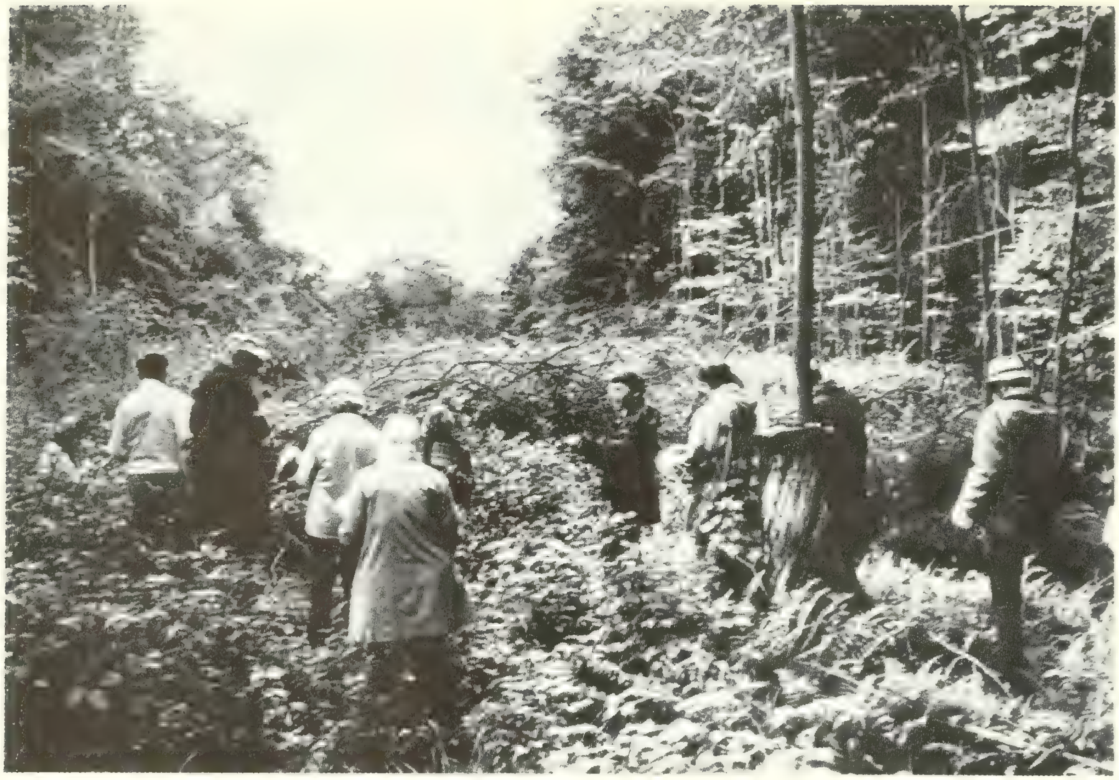

Figure 1--A group reacts to the on-site results of a strip clearcut.

The first question about each tract consisted of 16 bipolar adjective pairs. This semantic differential measured a viewer's indirect evaluation of a tract. In the second question, respondents were asked to indicate their overall impression (direct evaluation) of the appearance of each tract by rating it on a five-point scale from very favorable to very unfavorable.

Respondents also were asked to describe why they felt the way they did about each tract, and to what extent each of 10 site characteristics influenced their overall impression of a tract.

RESULTS AND DISCUSSION

The semantic differentials for each tract were factor-analyzed. Communalities of variables used in the analysis were generally .4 or greater, and sometimes exceeded .9. Identification of an evaluative factor was based on variables in the Factor I varimax rotated factor matrix that had loadings of .4 or greater. The adjective pairs that made up the evaluative factor are: fragrant-foul, good-bad, beautiful-ugly, clean-dirty, pleasant-unpleasant, sacred-profane, and valuable-worthless.

Evaluative factor scores (indirect reactions) were computed for each respondent by summing the raw scores for the seven word pairs for each tract. Means and standard deviations were then determined for each tract (table 1). Scores ranged from 16.81 to 26.69.

The overall impression scores represent direct reactions to each tract. They were derived by summarizing individuals' scores from the questionnaire's 5-point overall impression scale and computing means and standard deviations (table 1). Scores ranged from 2.31 to 3.96. The overall impression scores (OVIMP) for each tract were then compared to the evaluative factor scores; correlation coefficients ranged from .505 to .882. The relationships between the direct and indirect evaluations were highly significant (table 1). This means that the OVIMP and semantic differential scores are reliable proxies for one another. The fact that they agree to such an extent means that they are probably accurate indicators of the reactions of these viewers to these harvesting procedures.

Table 1--Correlations between indirect and direct responses to harvested tracts

Location	Mean Overall Evaluative Factor Score 1/	Standard Deviation	Mean Overall Impression Score 1/	Standard Deviation	Correlation Coefficient
Camden (N = 22)					
1. Top-lopped partial	17.14	6.06	2.41	1.26	.791*
2. Unlopped partial	19.27	5.63	2.77	1.23	.799*
3. Top-lopped strip	22.68	9.22	3.70	1.17	.700*
4. Unlopped strip	19.27	8.02	3.29	1.15	.640*
5. Top-lopped patch	20.68	4.35	3.00	.98	.505*
6. Unlopped patch	22.95	4.97	3.41	1.05	.722*
Cuyler (N = 35)					
1. Top-lopped partial	18.77	5.96	2.60	1.15	.813*
2. Unlopped partial	20.41	5.50	2.97	1.04	.817*
3. Top-lopped strip	20.69	6.99	2.82	1.26	.838*
4. Unlopped strip	24.11	6.22	3.38	1.23	.859*
5. Top-lopped patch	19.83	6.64	2.77	1.26	.882*
6. Unlopped patch	24.79	5.85	3.50	1.26	.761*
Northville (N = 86)					
1. Top-lopped partial	16.81	4.78	2.31	1.05	.749*
2. Unlopped partial	17.88	6.41	2.52	1.17	.861*
3. Top-lopped strip	26.11	5.62	3.69	1.11	.773*
4. Unlopped strip	26.69	5.45	3.96	1.07	.683*
5. Top-lopped patch	23.75	6.14	3.42	1.16	.832*
6. Unlopped patch	25.85	5.41	3.65	1.09	.698*

* Highly significant ($P < .01$) 1/ Lower scores reflect more favorable reactions

After satisfying the requirement that the direct and indirect measurements agreed, the next step was to examine the data to determine viewer reactions and preferences. Table 1 indicates that there is a general preference for partial cuts over clearcuts and that patch clearcuts are probably preferred over strip clearcuts. The data also imply that top-lopped tracts are preferred over tracts that had not been top-lopped.

These observations were investigated at each location using three-way analysis of variance. The overall impression scores at each location were tested for differences due to top-lopping, for differences due to cutting methods and for differences due to groups. In addition, the three-way analysis of variance provides an opportunity to test for interactions between these three sources of variance.

After the analysis of variance was completed (Nyland et al. 1976), it was concluded that a partial cut selection system was perceived more favorably than a patch cut system, and that a patch cut system was perceived more favorably than a strip clearcut system. A second conclusion drawn from the analysis was that there is some question about viewers' perception of top-lopping. It was concluded that top-lopping may not have been an aesthetically effective post-logging practice, except in one strictly sawlog operation that had been clearcut. At this location, there was a considerable amount of large-sized slash left lying on the ground. At the other two locations, many of the larger pieces not taken as sawlogs were subsequently taken for pulpwood.

The analysis of variance did confirm the notion that groups with different affiliations tend to be more critical or less critical of harvested tracts, depending on their group's affiliation. In spite of this, there is a tendency for some agreement about the order in which the tracts were rated, regardless of group affiliation. Partially cut tracts tend to be viewed more favorably than clearcuts, and most groups rated the patch clearcuts more favorably than the strip clearcuts.

With this information at hand, it was possible to delve deeper into the semantic differential to see if any light could be shed on reasons for viewer reactions to the harvesting procedures. In addition to the evaluative factor that emerges as an index of attitudes, semantic differential data invariably produce other factors. Two of the factors that frequently emerge from factor analysis of semantic differential data are, a potency factor and an activity factor. The potency factor is usually related to "power and the things associated with it, size, weight, toughness, and the like;" the activity factor is "concerned with quickness, excitement, warmth, agitation and the like" (Osgood et al. 1957:73). The potency factor (Factor II) was represented in this study by the adjective pairs: unique-commonplace, delicate-rugged, smooth-rough, humorous-serious, and gentle-violent; the activity factor (Factor III) was represented by the adjective pairs: varied-repetitive, active-passive, hot-cold, and vibrant-still.

Of the five word pairs that represented Factor II, three were loaded in excess of .4 often enough to make up a potency factor. They are: delicate-rugged, smooth-rough and gentle-violent. For Factor III, two word pairs emerged to represent the activity factor. They are active-passive and vibrant-still.

Mean potency and activity factor scores were computed for each tract in the same manner as mean evaluative scores (table 2). At Camden and Northville, the partially cut tracts with top-lopping had the lowest mean potency factor scores. At Cuyler, the strip clearcut tract that had been lopped produced the lowest mean potency factor score. The highest mean potency factor scores occurred for the unlopped partial cutting at Camden, the unlopped patch clearcutting at Cuyler and the unlopped strip clearcutting at Northville. The latter two tracts at Cuyler and Northville also elicited the most unfavorable overall impression scores from respondents. This suggests that unfavorable reactions to harvested tracts may be related to a perception of roughness, ruggedness, or violence. The correlations between overall impression scores and mean potency factor scores (Factor II) were highly significant for 17 out of 18 tracts.

Table 2--Mean potency (Factor II) and activity (Factor III) scores with standard deviations

Location	Factor II (SD)	Factor III (SD)
Camden (N = 22)		
1. Top-lopped partial	9.95(2.55)	5.77(2.14)
2. Unlopped partial	11.64(1.76)	4.77(1.57)
3. Top-lopped strip	11.36(2.98)	5.82(2.54)
4. Unlopped strip	10.14(2.73)	4.86(2.14)
5. Top-lopped patch	10.95(2.44)	5.86(1.98)
6. Unlopped patch	11.09(1.90)	6.36(1.79)
Cuyler (N = 35)		
1. Top-lopped partial	10.26(2.70)	5.95(1.82)
2. Unlopped partial	10.77(2.02)	5.85(1.41)
3. Top-lopped strip	9.00(3.04)	6.66(1.99)
4. Unlopped strip	11.31(2.17)	6.23(1.54)
5. Top-lopped patch	9.91(2.37)	6.11(2.15)
6. Unlopped patch	11.60(2.17)	5.69(2.21)
Northville (N = 86)		
1. Top-lopped partial	9.19(2.44)	5.64(1.71)
2. Unlopped partial	10.51(2.87)	5.39(1.89)
3. Top-lopped strip	11.19(2.64)	6.28(2.52)
4. Unlopped strip	12.27(2.05)	6.87(2.52)
5. Top-lopped patch	10.44(2.92)	5.31(2.92)
6. Unlopped patch	11.09(2.85)	5.14(2.70)

The mean activity factor scores were not similarly related to the overall impression scores; only 4 of the 18 correlations were highly significant. This probably means that people do not find landscapes favorable or unfavorable based on perceptions of activeness or passiveness or of vibrancy or stillness.

Although the three adjective pairs (delicate-rugged, smooth-rough, and gentle-violent) helped describe potency factors in other studies, they more nearly identify what might be described as a "perceived orderliness factor" for the recently harvested forest tracts in this study. The data suggest a relationship between perceived orderliness and overall impression scores; that is, if a harvested tract is perceived as having a degree of order about its appearance--regardles of the harvesting procedure, the tract may produce a more favorable reaction than if it is perceived to be chaotic in appearance.

This notion is given some credence in previous work. In studying the reactions of suburban forest owners to photos of common forest practices, Hamilton *et al.* (1973) concluded: "The orderly piling of cordwood as well as slash gave an impression of neatness and industrious endeavor despite the intensive logging that was being done at the time." In commenting on results of a study of judgments of representational paintings by nonartists, Osgood *et al.* (1957:70) stated: "It is evident that 'goodness' in representational paintings is identified with 'orderliness' and 'clarity' rather than with the more abstractly moral attributes with which we are familiar from our previous more general analyses." Calvin *et al.* (1972) described research by Sanoff in 1969 that identified an "orderliness" factor, and research by Vielham in 1966 that identified a "physical organization" factor emerging from semantic differential data. These studies, like the present study, used landscape scenes rather than concepts as the basis for their analyses.

In this study, the high correlations between overall impression scores and Factor I scores helped validate *which* landscapes were preferred. The high correlations between overall impression scores and Factor II (perceived orderliness) scores shed some light on *why* some of the tracts were rated more favorably than others. Viewers tended to be more favorably impressed with tracts that were perceived as delicate, smooth, or gentle. They tended to be more unfavorably impressed with tracts that were perceived as rugged, rough, or violent.

A second opportunity to examine why some tracts are rated more favorably than others is provided by data obtained from another question in the Timber Removal Evaluation Packet. This question permitted a respondent to identify how much influence each feature had on his overall impression of a tract. Analysis of data from this question showed that four features were perceived as most important: high slash, low slash, obstructions to walking on trails and distance you can see into a forest from a trail. All four of these features can be logically associated with a viewer's perception of orderliness in a forest scene.

Finally, field measurements of two features were significantly correlated to overall impression scores. The features were the distance one could see into a forest from a trail and areas of bare soil at the center of the logging site. These two features plus the cutting method, plus the presence or absence of top-lopping at a site were submitted to stepwise multiple regression analysis as independent variables along with each tract's overall impression score as the dependent variable. The equations developed from the analysis that explained 81 percent of the variation in overall impression scores among the 18 tracts are as follows:

TRACT	PREDICTION EQUATION*
Partial cut	
-- lopped	Impression score=2.695-0.092D+0.01S
--unlopped	Impression score=2.909-0.092D+0.01S
Clearcut strips	
-- lopped	Impression score+3.369-0.092D+0.010S
--unlopped	Impression score=3.583-0.092D+0.010S
Clearcut patches	
-- lopped	Impression score=3.242-0.092D+0.010S
--unlopped	Impression score=3.456-0.092D+0.010S

where D = distance visible into the forest in feet

S = area of bare soil, in percent of surface area.

*The lower the score, the more favorable the overall impression.

According to the equation, a tract's overall impression improves as the distance one can see into the forest from a trail increases; overall impression becomes more unfavorable with increase in areas of bare soil; and it improves when top-lopping is included.

The percent error between actual OVIMP and estimated OVIMP is presented in Table 3. There are about as many estimated scores above the actual OVIMP as there are below, which means that the regression is fairly accurate. Average percent error is less than 6 percent, and this holds true for all three locations. This implies that the regression is fairly precise.

CONCLUSION

Use of the semantic differential technique contributed toward validating viewer responses to inquiries about landscape preferences. It is recognized that these results are based on verbal reactions and that they may have been subject to preconceived viewer biases. However the direct verbal reactions were highly correlated with two indirect measures. The data suggest that viewers prefer selection cutting over clearcutting, and patch clearcutting over strip clearcutting. Viewers tended to favor tracts they perceived as delicate, smooth, or gentle. There is some tendency for viewers to favor top-lopped tracts over unlopped tracts. There were significant differences in the way various groups of viewers reacted to harvested tracts. In addition to validating the direct reactions, semantic differential data contributed to a partial explanation of why some tracts were rated more favorably than others. And the relationship of physical features, logging procedures and top-lopping with overall impressions of harvested tracts was demonstrated through the use of regression analysis.

Table 3--A comparison of actual OVIMPS with estimated OVIMPS

Tract	Overall impression scores		Percent Error
	Actual	Estimated	
Camden			
Partial--lopped	2.4	2.6	+8.3
--not lopped	2.8	2.8	--
Clearcut strip--lopped	3.7	3.3	-10.8
--not lopped	3.3	3.5	+6.1
Clearcut patch--lopped	3.0	3.2	+6.7
--not lopped	3.4	3.5	+2.9
Cuyler			
Partial cut--lopped	2.6	2.5	-3.8
--not lopped	3.0	2.7	-10.0
Clearcut strip--lopped	2.8	3.1	+10.7
--not lopped	3.4	3.5	+2.9
Clearcut patch--lopped	2.8	2.9	+3.6
--not lopped	3.5	3.4	-2.9
Northville			
Partial cut--lopped	2.3	2.6	+13.0
--not lopped	2.5	2.4	-4.0
Clearcut strip--lopped	3.7	3.4	-8.1
--not lopped	4.0	4.0	---
Clearcut patch--lopped	3.4	3.2	-5.9
--not lopped	3.6	3.5	-2.8

This approach to on-site landscape assessment required personal interaction with several potential and actual groups of viewers. The time involved must be treated as a cost, but the unexpected goodwill and public understanding of forestry that resulted from the interaction were unplanned benefits. The cost of application would be positively correlated with the time spent recruiting groups and the number of groups viewing the harvested tracts. The cost of adding the semantic differentials to the Timber Removal Evaluation Packets and the added time respondents needed to fill in the scales for each tract were not burdensome. But the analysis and interpretation of data were considerably enriched by the increase in information.

The effectiveness of the semantic differential technique was demonstrated in the broad acceptance of the results by study participants. The anticipated results were borne out in the quantified form. This should also aid management in deciding which harvestin procedures to use on which forest stands. The study procedure should be transferrable to any situation in which an indirect measurement of landscape assessment is desired. The hardware and software requirements are easily available at any computer installation that has prerecorded programs.

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Identification of Scenically Preferred Forest Landscapes[1]

Roberta C. Patey and Richard M. Evans[2/]

Abstract: This study identified manipulated forest landscapes with a low understory shrub density as being esthetically preferred over non-manipulated, dense understory landscapes. This landscape pattern was identified both qualitatively, by preference ratings of respondents, and quantitatively, by measuring the physical components of each landscape. Forest sites were selected to show physically and vegetatively similar landscapes differing only by the presence or absence of a vegetation manipulation treatment. Color slides of these landscapes rated by groups of respondents revealed a consistent preference for manipulated scenes. Examination of the physical characteristics of the preferred scenes revealed reduced shrub density to be the major differing factor.

INTRODUCTION

A major problem facing scenic resource managers is identifying the types of forest landscapes which the public prefers. Once preferred landscape patterns are identified, guidelines can be developed and incorporated into management of scenic areas, campgrounds, road right-of-ways and other forested areas. This study was undertaken to provide land managers in Eastern Tennessee with practical objectives for attaining esthetically preferable forest landscapes.

Too often in the past, public input in natural resource management policies has been ignored, at times resulting in inaccurate management objectives. A study by Klukas and Duncan (1967) revealed that after surveying vegetational preferences among visitors to Itaska Park, Minnesota, it became apparent that there was a strong preference for old growth red pines *(Pinus resinosa* Ait.*)*. Yet, the existing park policy of fire repression was eliminating the reproduction of the preferred red pines which were the most scenically preferred vegetation. Without assessment of public preferences, park managers would have continued operating toward a less desirable forest management objective.

Another difficulty in identifying policies and objectives with regard to esthetics is incorporating them into existing land management practices. In making scenic assessments, it would be advantageous if scenic factors could be quantitatively identified as well as preferentially rated. It would be easier to incorporate quantitative esthetic assessments into existing management policies since other aspects of forest management are based on quantitative input. As Arthur (1977) has stated, "Resource managers are unlikely to turn to novel decision models solely to give equal consideration of nonpecuniary resources." Thus, the quantification of esthetic components would make them more readily adaptable to existing management plans.

In determining preferred landscapes, this study utilized a dual approach that combined both qualitative evaluation of the public's esthetic preferences for selected landscapes and quantitative assessment of the physical components of those landscapes. Color slides of selected forest sites were presented to groups of

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respondents who rated the sites on the basis of their perceived esthetic quality. These sites were also measured using established forest inventory procedures which recorded overstory, understory, and ground-cover size and density. This combination approach resulted in public selection of esthetically preferred landscapes and a quantitative record of the physical characteristics of preferred sites which can be easily understood and adapted to forest management practices.

LANDSCAPE ASSESSMENT PROCEDURES

Selecting Study Sites

The study sites were restricted to naturally vegetated forest landscapes in the eastern Tennessee region. No structures or man-made objects were present which might obscure the evaluation of the existing vegetation patterns. In keeping with the study's objective of incorporating esthetic preferences with practical management policies, sites were selected to show esthetic effect of established forest management practices. These practices focused on different means of vegetation manipulation and included burning, grazing and mechanical removal of vegetation. These manipulation practices alter the pattern of vegetation. In order to evaluate whether manipulated or non-manipulated patterns were preferable on the basis of esthetics, the selected sites were paired to show physically similar landscapes differing only by the presence or absence of a vegetation manipulation treatment. Thus, each pair of sites included one manipulated landscape which had received treatment within the previous two years and a corresponding non-manipulated control. The treatments primarily affected density of the understory vegetation in existing forest landscapes.

Time limitations for this study did not allow for the treatment and evaluation of predetermined sites. Instead, sites were selected which had received prior treatments so that an existing manipulation effect could be assessed. Each pair of sites was similar in topography, aspect, slope, stand composition, density and size of overstory vegetation. Treated and untreated paired sites were located in close proximity, often contiguous, to facilitate control of variances between sites. In addition to being classified by manipulation treatment, sites were also identified by forest type (i.e., hardwoods or pines). This meant that, when attainable, sites with a predominantly pine overstory as well as a predominantly hardwood overstory were selected for each treatment.

The research paradigm in figure 1 diagrams the sampling framework of the study and the number of replications attainable for each of the differing treatments. A total of 26 individual sites or 13 pairs of sites were selected. Due to difficulties in locating previously manipulated sites, the burning treatment was the only one that had an equal number of replications for hardwoods and pines. Only one pair of sites was located that represented grazed pine stands, and no acceptable mechanically treated pine stands could be located.

Photographing Selected Sites

Previous studies by Daniel and Boster (1976), Shafer and Richards (1974), and Zube (1974)

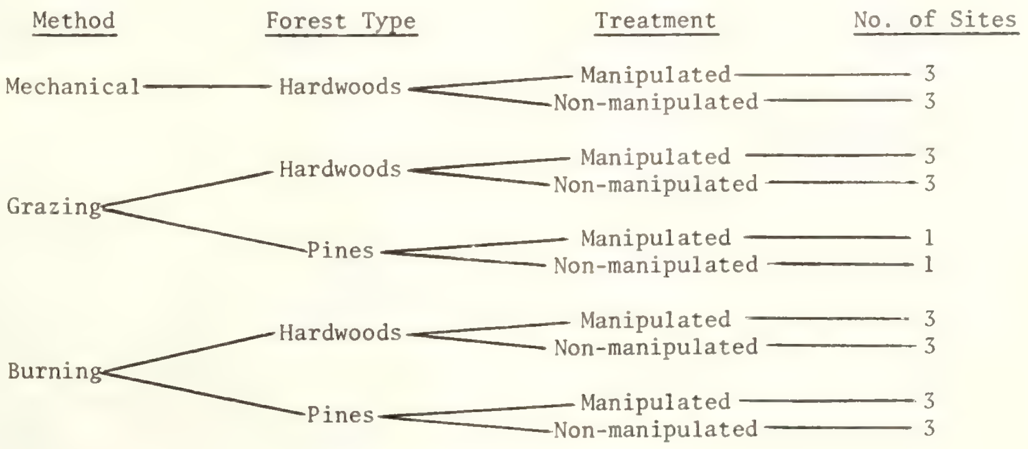


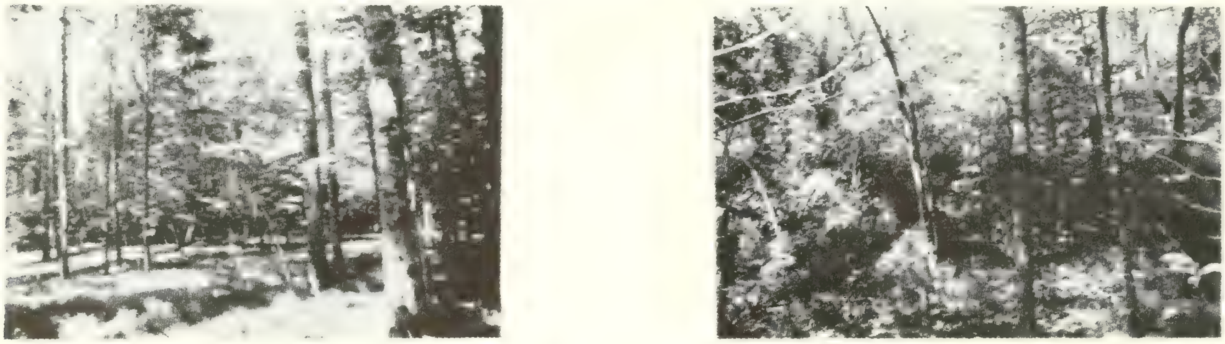
Figure 1--*Research paradigm for sampling of forest landscapes.*

have shown that color slides can accurately depict the actual landscape, and that a close relationship exists between preference responses to slides and to actual sites.

Following the selection of specific treatment and control sites, one-fifth acre plots were located within each site, photographed, and measured. The sites were photographed during June, July, August and September 1977, using a 35 mm camera and a 28 mm 1:2.5 automatic wide angle lens at an eye vantage point 50 feet from plot center. Paired sites were photograph at the same time of day from the same compass bearing to keep light levels constant and to duplicate shadow patterns. Photographing was restricted to sunny days between 10:00 a.m. and 4:00 p.m. and each camera setting was bracketed to assure slides of comparable lighting and photographic quality. Figure 2 presents selected sample pairs of slides for each manipulation by forest type treatment.

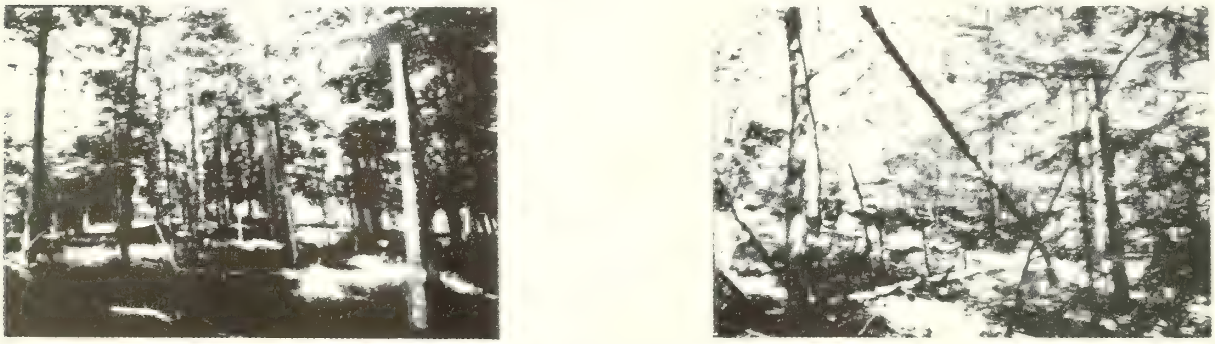
MECHANICALLY MANIPULATED HARDWOODS

Manipulated Non-manipulated



GRAZING MANIPULATED HARDWOODS

Manipulated Non-manipulated



GRAZING MANIPULATED PINES

Manipulated Non-manipulated

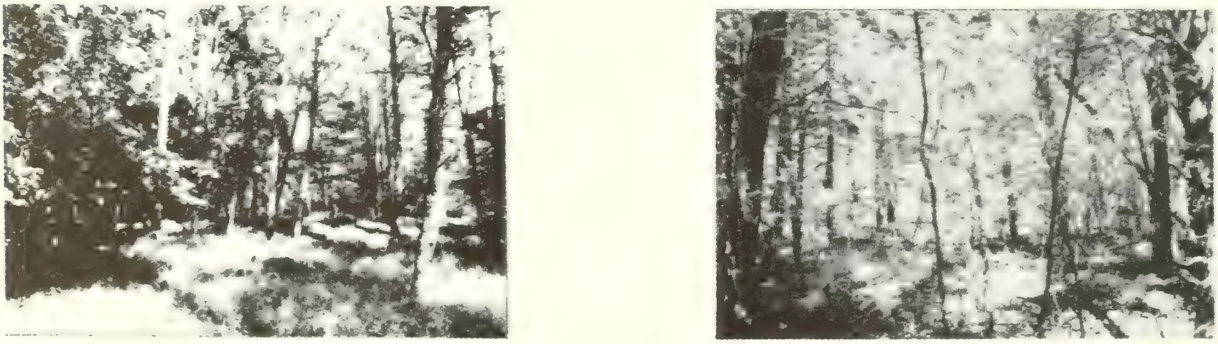
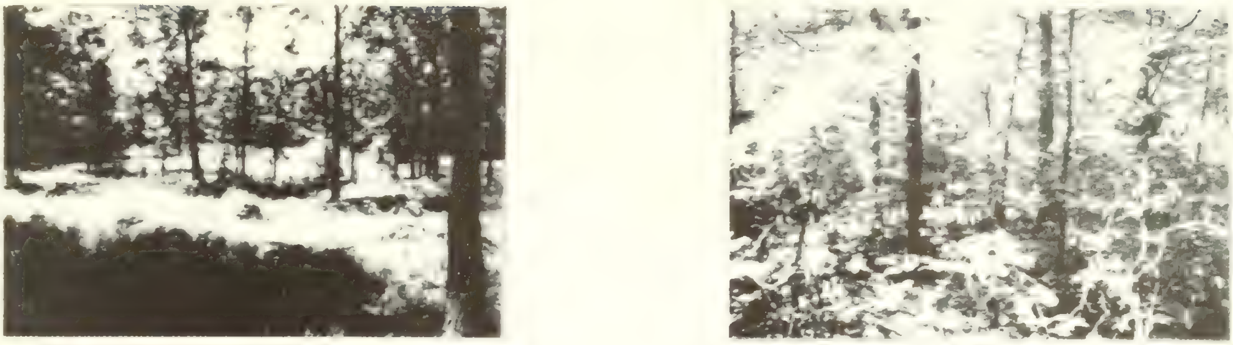


Figure 2-- *Sample of photographs of each manipulation by forest type landscape pair.*

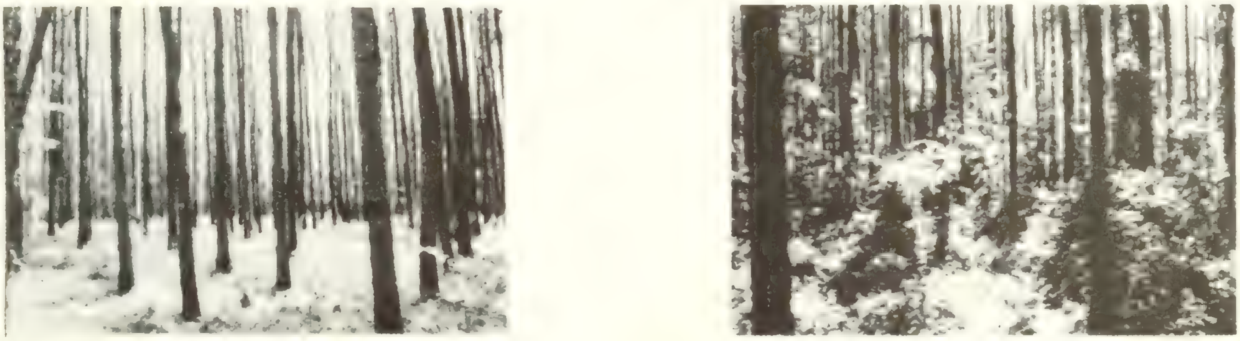
BURNING MANIPULATED HARDWOODS



Manipulated

Non-manipulated

BURNING MANIPULATED PINES



Manipulated

Non-manipulated

Figure 2-- *Continued*

Site Measurements

Measurements were taken at each site to quantify the vegetation composition and possibly provide a reference to aid in developing management guidelines for achieving preferred landscapes. The method for data collection was based on a Continuous Forest Inventory (CFI) system, a widely accepted method for measuring forest stands and easily understood and applied by professional land managers. Information recorded on each site gave a quantitative description of the timber and pulpwood in basal area per acre, shrub cover in number of stems per acre, and herbaceous ground cover in percent coverage per acre. Basal areas of timber and pulpwood trees were determined according to the CFI guidelines used by MacDonald (1964). Shrub cover was obtained by counting the number of stems measuring 3 feet tall to 5 inches dbh on one-hundreth acre plots (11.78-foot radius). Herbaceous ground cover was calculated by running a 50-foot transect line on a radius from plot center and tallying the number of herbaceous plants at one-foot intervals along the transect (Phillips 1959).

Preference Survey

Color slides were presented to groups of respondents who rated the slides on the basis of the "scenic beauty" of the represented areas following guidelines and terminology used by Daniel and Boster (1976). Rutherford and Shafer's (1969) techniques were also used in projecting the slide pairs simultaneously on side-by-side screens. Respondents were given no advance information about the nature of the study. Manipulated and non-manipulated landscapes were randomly assigned to left and right positions for each projected pair. Pairs, themselves, were randomized before each group presentation.

Respondents rated both the left and right positions slides for each projected pair on a 1-to-5 scale with 1 representing low scenic beauty and 5 representing high scenic beauty. Standardized instructions were read to the respondents prior to rating the slides. An example pair of slides was projected on the screens following the instructions so that respondents would fully understand the rating process and be familiar with the type of slides to expect. Slides were projected for 20 seconds per pair as in a similar study by Rutherford and Shafer (1969). Following the slide rating, respondents were asked to complete a questionnaire which provided additional background on the respondents' age, sex, education, occupation, and tested their knowledge of the use or effects of vegetation manipulation methods portrayed in the slides.

Sampling, as noted earlier, was conducted on a group basis similar to the grouping used by Daniel and Boster (1976). Respondents were restricted to persons in the eastern Tennessee area, and a total of 9 groups (or 176 individuals were sampled.

In an attempt to categorize preference responses into a more usable form by land managers, the groups selected to participate were classified into those knowledgeable and trained in assessing natural resources ("experts") and those who by their group affiliation may or may not have any training or special interest in environmental concerns ("non-experts"), again similar to Daniel and Boster (1976). Classification was not completely arbitrary and was aided by information attained from the questionnaires. The groups classified as experts included conservation and wildlife societies and university students in forestry and landscape design classes. Non-expert groups included private and civic organizations such as a garden club and a Sunday school class.

ANALYSIS

Data analysis in this study focused on examining respondents' preferences for the manipulated and non-manipulated landscape pairs and determining whether group affiliation (specifically "expertise" and knowledge in the field of natural resources) affects preference responses

The effects of manipulation (MNP), pairs (PAIR), individuals (IND) and their classification into groups (GROUP), and the interaction o these factors on respondents' preferences were examined using analysis of variance (table 1). Analyses were conducted on a within treatment/forest type basis which resulted in five separate analyses: (1) mechanical/hardwoods, (2) grazing/hardwoods, (3) grazing/pines, (4) burning/hardwoods, and (5) burning/pines. Since complete replications of forest types and manipulation techniques could not be obtained, valid comparisons could only be made on the ratings for the manipulated and non-manipulated landscapes in each pair of sites. Therefore, inferences are not made regarding specific treatments or forest types.

Differences among groups were examined by partitioning the GROUP x MNP interaction into component comparisons by means of orthogonal contrasts (Steel and Torrie 1960).

Table 1--*ANOVA models for preferences within treatment/forest type.*

SOURCE	D.F.	MEAN SQUARES MECHANICAL/HDWDS.	GRAZED/HDWDS.	GRAZED/PINES	BURNED/HDWDS.	BURNED/PINES
MNP	1	96.3645**A	14.0947**	35.0028**	90.4176**	18.8267**
PAIR	2	10.5237	43.9858	-------	6.2112	5.8419
MNP x PAIR	2	9.5407	26.0862	-------	21.0767	3.4858
ALL IND	175	2.1005	2.3397	1.1996	2.3512	2.2233
GROUPS	8	2.6445 B	4.4123	1.4613	4.1318	4.5392
IND (GROUPS)	167	2.0744	2.2405	1.1871	2.2659	2.1124
MNP x ALL IND	175	1.5589	1.4147	0.8600	2.0462	2.1581
GROUPS x MNP	8	3.2226*A	1.1401	1.1644	1.7133	5.6683**
IND x MNP (GROUPS)	167	1.4792	1.4279	0.8454	2.0621	1.9900
RESIDUAL	700	0.5370	0.7569	------	0.6335	0.6000

[A] NOTE: INTERACTION OF IND x MNP (GROUPS) DEEMED APPROPRIATE FOR TESTING SIGNIFICANCE OF MNP AND GROUPS x MNP.

[B] NOTE: INTERACTION OF IND (GROUPS) DEEMED APPROPRIATE FOR TESTING SIGNIFICANCE OF GROUP.

*STATISTICALLY SIGNIFICANT AT 0.05 PROBABILITY LEVEL.

**STATISTICALLY SIGNIFICANT AT 0.01 PROBABILITY LEVEL.

RESULTS

Analysis of the preference ratings indicated a significant preference for manipulated landscapes. This preference was consistent across all groups. In all 9 groups, the average ratings were higher for the manipulated landscapes (table 2). Overall mean rating was 3.52 (on a 5-point scale) for manipulated landscapes and 3.06 for non-manipulated landscapes.

Table 2--*Mean preference ratings* by groups for manipulated and non-manipulated landscapes within each pair of slides.*

GROUP	MEAN PREFERENCE RATINGS MANIPULATED	MEAN PREFERENCE RATINGS NON-MANIPULATED
WILDLIFE SOCIETY	3.40	3.23
SOUTHERN HIGHLAND CONSERVANCY	3.62	3.13
FOREST RECREATION CLASS	3.52	2.97
LANDSCAPE DESIGN CLASS	3.62	3.29
HORTICULTURE CLASS	3.72	3.33
SUNDAY SCHOOL CLASS	3.49	3.00
ARBORETUM SOCIETY	3.13	2.80
GARDEN CLUB	3.20	2.94
ROTARY CLUB	3.59	2.79

*PREFERENCE RATINGS WERE BASED ON 1 TO 5 SCALE WITH 1 REPRESENTING LOW SCENIC BEAUTY AND 5 REPRESENTING HIGH SCENIC BEAUTY.

The orthogonal contrasts (among groups) revealed few significant differences and specifically no significant difference in preferences between the "expert" and "non-expert" categories. These findings correspond to studies by Daniel and Boster (1976) and Zube et al. (1975) which found an overall high agreement between experts and non-experts on landscape evaluation and description.

The only recurring significant difference was a contrast involving the wildlife society group. Although all groups preferred manipulated landscapes, (as indicated in table 2), the wildlife society had a lower degree of preference than the other groups, possibly due to the special interests of this group which indicated a concern for wildlife habitats and a preference for landscapes with enough shrub cover to support wildlife species. Although this may suggest that special interests of groups may affect the degree of preference, the magnitude of special interest effects relative to overall preference for manipulated landscapes was extremely small.

Physical measurements describing both the manipulated and non-manipulated sites as well as the corresponding mean preference ratings are presented in table 3. In viewing the landscape pairs (fig. 2), there is an apparent visual

Table 3--*Summary of descriptive physical components of landscape study sites.*

PAIR	TREATMENT	METHOD	FOREST TYPE	TIMBER (BASAL AREA PER ACRE)	PULPWOOD (BASAL AREA PER ACRE)	SHRUB COVER (NUMBER STEMS/ACRE)	HERBACEOUS GROUND COVER (PERCENT/ACRE)	PREFERENCE RATING (MEAN)
1	MANIPULATED	MECHANICAL	HARDWOOD	87.60	27.00	600	92 %	3.91
	NON-MANIPULATED	MECHANICAL	HARDWOOD	81.60	33.40	3200	60 %	3.62
2	MANIPULATED	MECHANICAL	HARDWOOD	55.05	33.00	300	100 %	3.89
	NON-MANIPULATED	MECHANICAL	HARDWOOD	54.05	17.70	2900	64 %	2.94
3	MANIPULATED	MECHANICAL	HARDWOOD	81.10	69.20	0	92 %	3.89
	NON-MANIPULATED	MECHANICAL	HARDWOOD	58.65	21.00	3000	62 %	3.34
4	MANIPULATED	GRAZING	PINE	91.85	38.90	200	100 %	3.58
	NON-MANIPULATED	GRAZING	PINE	112.35	49.80	2700	36 %	2.84
5	MANIPULATED	GRAZING	HARDWOOD	70.95	55.00	200	88 %	3.89
	NON-MANIPULATED	GRAZING	HARDWOOD	120.20	18.00	1000	22 %	3.54
6	MANIPULATED	GRAZING	HARDWOOD	97.30	37.90	0	100 %	2.86
	NON-MANIPULATED	GRAZING	HARDWOOD	112.40	30.50	1100	70 %	3.21
7	MANIPULATED	GRAZING	HARDWOOD	105.45	26.50	300	46 %	3.56
	NON-MANIPULATED	GRAZING	HARDWOOD	86.35	32.00	2400	70 %	2.94
8	MANIPULATED	BURNING	HARDWOOD	17.05	25.60	0	82 %	3.42
	NON-MANIPULATED	BURNING	HARDWOOD	10.70	37.80	3300	76 %	2.97
9	MANIPULATED	BURNING	HARDWOOD	31.45	25.10	200	76 %	3.57
	NON-MANIPULATED	BURNING	HARDWOOD	17.30	15.50	3400	28 %	2.48
10	MANIPULATED	BURNING	HARDWOOD	33.45	1.50	0	92 %	3.37
	NON-MANIPULATED	BURNING	HARDWOOD	45.95	17.50	2400	20 %	3.19
11	MANIPULATED	BURNING	PINE	78.25	40.80	600	84 %	3.19
	NON-MANIPULATED	BURNING	PINE	73.80	79.10	600	84 %	2.68
12	MANIPULATED	BURNING	PINE	113.05	43.20	400	80 %	3.20
	NON-MANIPULATED	BURNING	PINE	104.70	18.80	1200	82 %	2.12
13	MANIPULATED	BURNING	PINE	99.05	19.60	200	86 %	3.38
	NON-MANIPULATED	BURNING	PINE	111.90	10.30	700	78 %	3.10

difference in density of vegetation between manipulated and non-manipulated sites. This observation is supported by data in table 3. Shrub density averaged 230.77 stems per acre on manipulated sites and 2145.15 stems per acre on non-manipulated sites. This decrease in shrub cover on preferred sites corresponds to an accompanying increase in herbaceous cover. The average herbaceous cover was 86.0 percent for manipulated sites and 77.8 percent for non-manipulated sites. A composite of landscape preference ratings and landscape site data indicates that on the basis of scenic beauty, respondents preferred landscapes with less dense woody shrub cover and a higher percent of herbaceous ground cover.

CONCLUSIONS

The most apparent result of this study was the strong preference for landscapes with a low density of woody shrub cover. As indicated in table 3, this was the site measurement that showed the greatest variation between manipulated and non-manipulated sites. The number of stems per acre appears to be the physical site component responsible for the preferred manipulation pattern. It thus appears that the visually preferable forest landscape is open and park-like in appearance with a low density of understory shrubs. The objective of reducing understory shrub density to improve the esthetic quality of forest landscapes gives scenic resource managers a goal that is easily understood, realistically achieved through established management practices, and readily incorporated into existing management policies.

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Visual Management System and Timber Management Application[1]

Warren R. Bacon and Asa D. (Bud) Twombly[2]

Abstract: This paper includes an illustration of a planning process to guide vegetation management throughout a travel route seen area and over the time period of a total management rotation (100-300 years). The process will produce direction on visual characteristics to be created and maintained within the biological potential and coordinated with associated resource objectives. Conceptual treatments to achieve that direction will be shown for a ponderosa pine plant community.

The concept of managing vegetation (visual aspects) through timber harvest is both applied and theoretical. Field examples where it has been applied are included.

INTRODUCTION

The Visual Management System provides an inventory and recommended objective setting process. Its purpose is to provide visual resource input into all levels of planning, design and administration of National Forest lands. The recommended Visual Quality Objectives (VQO's) resulting from the System, except for preservation, each describe a different degree of retention or acceptable alteration of the natural appearing landscape based upon the importance of aesthetics.

The VQO's and the short-term alternatives of enhancement and rehabilitation are more completely defined for immediate visual effects in the USDA Handbook #462. But when applied to the planning and design of timber harvesting over time and space, they require a more detailed definition of design criteria, establishment of a management planning process and development of silvicultural treatments.

It is the purpose of this paper to provide suggested solutions to such planning, landscape design, and silviculture treatment problems. It is assumed that the reader has reviewed the problem statement on ponderosa pine which is part of the simulated field trip on TIMBER.

LANDSCAPE DESIGN AND VQO'S

1. The "desired character" to be retained or created.
2. The "negative elements" creating undesirable contrast such as activity residues, skid roads, skyline cable corridors.
3. The "positive elements" of water forms, rock forms, distinctive vegetation and spaces, which may be introduced or emphasized by removing, thinning, or planting surrounding vegetation.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979. This paper is taken from National Forest Landscape Management, Vol. 2, ch. 5 (Timber). U.S. Dep. Agric., Handbook No. 559, approximately 250 pages, illus. to be printed in the Fall of 1979. The handbook will contain all photographs and diagrams omitted from this paper due to lack of space and color printing restrictions.

[2] Landscape architect and silviculturist, USDA, Forest Service, Region 6, Portland, Oregon.

Desired Character

The desired character is the appearance of the landscape to be retained or created over time. A description of desired-character should include the appearance of the stands at regeneration, seedling-sapling stage as well as poles, small and large saw log sizes, the mature stand and, where appropriate, old-growth stand characteristics. The desired-character description may set goals for featured species, scale of stand structure, tree diameters, bark characteristics, textural patterns, and contrasting tree species, shrubs and ground covers. It should also include the distribution and proportion of different successional stages and size classes necessary in a managed state to achieve the mature character in some designed proportion of the viewed area over time.

Any design of the desired character must recognize that a forest is a dynamic and constantly changing community of plants and animals. The manipulation of this dynamic situation to achieve a desired variety of conditions is the essence of a managed forest.

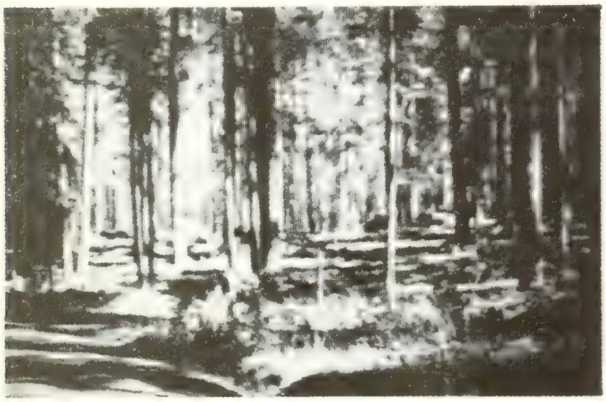

Figure 1--Before

This Douglas-fir stand is in an intermediate stage toward the desired character goal of 36" dbh with deep furrowed bark. Since all of the foreground within the corridor is of this size class, only a portion should be thinned to grow on to the desired size.

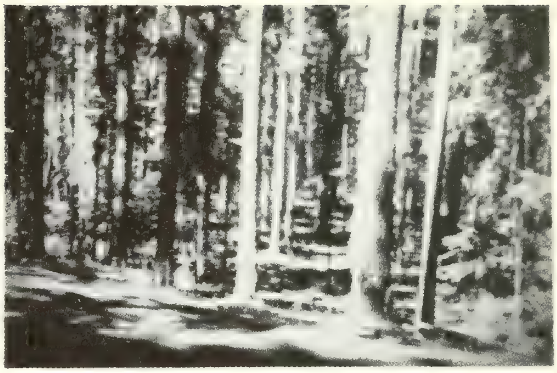

Figure 2--After shelterwood harvest
The positive elements of vertical line, color and texture of the ground vegetation and low-branched trees have been retained while moving this stand toward replacement of these characteristics in this travel route segment.

Negative Elements

Negative or unnatural-appearing elements of timber harvest should meet VQO definitions.

The next two figures illustrate the extremes of negative element contrast. Each harvest entry is moving its respective foreground landscape toward regeneration of a new stand of trees, but with vastly differing amounts of contrast, consequently meeting different VQO's.

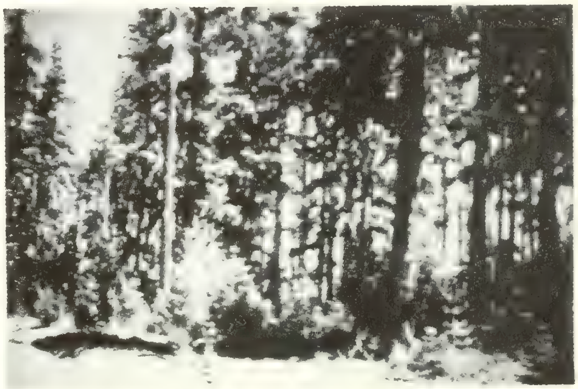

Figure 3--In this shelterwood harvest, contrast is not evident. This entry meets the RETENTION VQO.

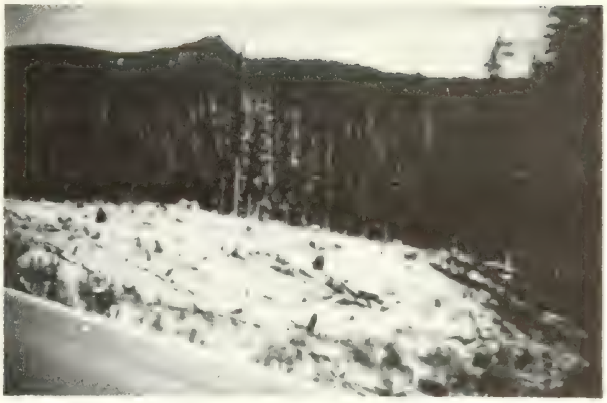

Figure 4--This clearcut unit creates a dominant soil color contrast, while the unit is out of scale for a foreground activity. This activity would probably be acceptable only under the MAXIMUM MODIFICATION VQO.

Positive Elements

Generally, considerable change can take place in the positive or natural-appearing elements even under RETENTION VQO if the change achieves desirable variety and follows the principles of landscape design. Here is an example of short-term enhancement for a retention landscape by manipulation of positive elements.

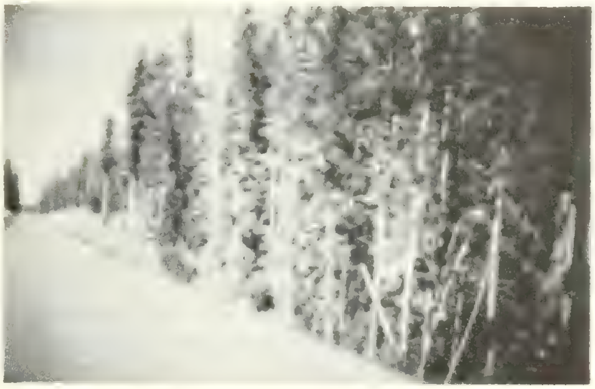

Figure 5--Before - This foreground stand is a combination of lodgepole and ponderosa pine. The lodgepole has formed a very dense dog-haired thicket near the road's edge. The visual effect lacks diversity of vegetative character and visual depth into the stand.

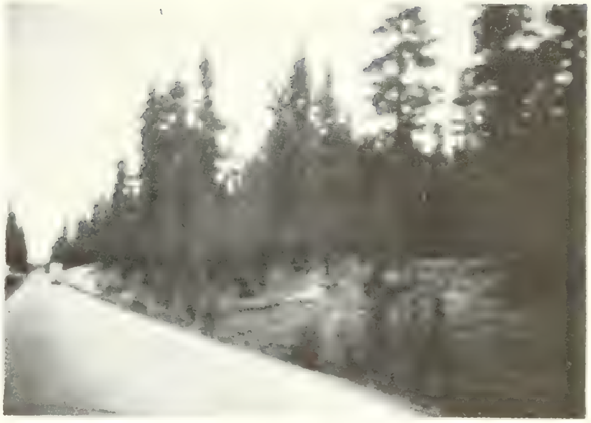

Figure 6--After - Removal of the stagnant lodgepole stand has added visual depth into the stand as well as releasing the more interesting ponderosa pine saplings to grow and develop to maturity. Stress has also been lessened on the few mature yellow bark trees adding their character to the scene for a longer period of time.

Planning the Corridor Viewshed

A corridor viewshed is defined as the total landscape seen or potentially seen from all or a logical part of a travel route, use area, or water body. The purpose of corridor viewshed planning is to provide the management direction for retaining or creating the desired forest character in an attractive sequential arrangement over time and space. This planning should provide the necessary supporting size classes and successional stages to maintain that desired character indefinitely.

In land management planning, corridor viewsheds are those areas selected for intensive visual management.

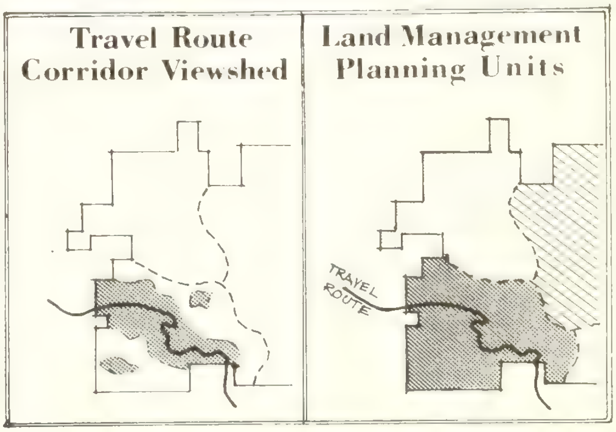
Travel Route Corridor Viewshed
Land Management Planning Units
TRAVEL ROUTE

Figure 7--Travel route corridor viewshed and land management units.

A corridor viewshed should include foreground, middleground, and background distance zones.

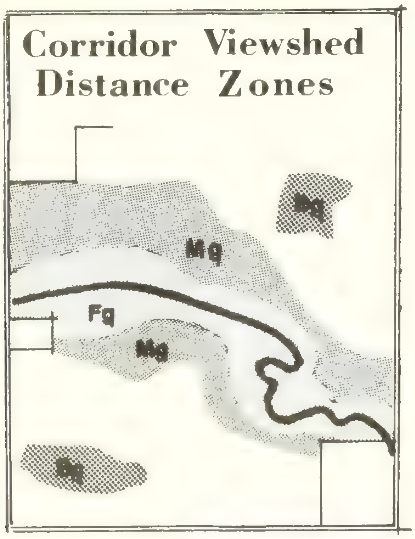

Figure 8--Corridor viewshed distance zones.

Process

Possible planning processes to establish management direction for corridor viewsheds are of necessity quite varied in both character and intensity. The flow diagram and procedural steps are intended to show the general relationship of inventory, analysis, and direction elements which are necessary in most cases.

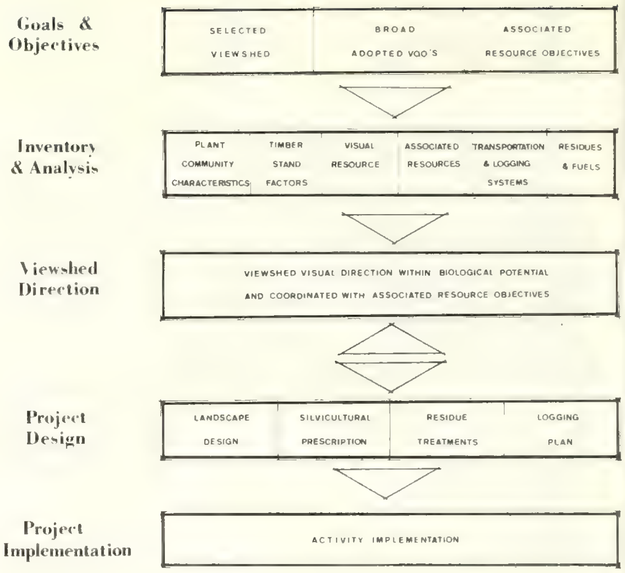

Figure 9--Process.

Step 1

First identify goals and objectives. Assuming viewshed boundaries have been established, list land use allocation objectives established in land management plans as they relate to corridor viewshed such as a Timber-Visual Allocation which states "manage for timber production in meeting adopted Visual Quality Objectives" or Roaded Recreation allocation which states "timber harvest should be done primarily to enhance the visual resource."

Step 2

List Visual Quality Objectives adopted for the viewshed:

(a) RETENTION for foregrounds,

(b) PARTIAL RETENTION for middleground, background, and unseen class A features.

Step 3

Next, an interdisciplinary team should inventory the factors that will affect establishment of viewshed direction. Some of the data may be available from previous functional and land use studies.

This community of factors is extremely complex, since most of its parts are such that an interdisciplinary team should establish biological units which will react the same or nearly the same to vegetative manipulation. In this case a segment of the corridor viewshed was chosen which contained both climax ponderosa pine and aspen plant communities.

Step 5

Identify and record areas where for visual, recreation, or associated resource reasons, management will be significantly different.

Step 6

The interdisciplinary team should then combine these two inventories to establish management response units. A management response unit is defined as a homogenous vegetative unit from biological, social and management standpoints.

Other situations which might constitute separate management response units include such things as:

Calving Areas
Winter Sports Areas
Cultural Features
Utility Corridors
Fuel Breaks
Watersheds (water supply)

The climax ponderosa pine foreground management response unit will be used as the example throughout the rest of the process.

Step 7

Analyze existing foreground stand character particularly if significantly different from that desired or that can be maintained over time. In this example it is primarily, "open park-like stands of old-growth, deep-furrowed, yellow-bark pine ranging in diameter from 24-48 inches."

Step 8

Determine the desired visual character from conditions which currently exist, historically are known to have existed or conditions that are known to be biologically possible. Adjust desired character to reasonable biological constraints and management limitations. If we are always to have old growth open-park-like stands somewhere within the Foreground, we must have a balance of all site classes; each class will predictably move into the next larger size class until old growth tree character is reached. Then these trees, in turn, either die naturally or are harvested. An identified range of desired characteristics offers the opportunity to creat both biological and design diversity in an attractive sequence as one moves down the corridor.

Figure 10 illustrates schematically existing foreground vegetative characteristics and biological capabilities as the basis for determining desired visual character. The desired quantity of each size class is based on the proportion of each necessary to maintain 20 per cent of the foreground in old-growth character indefinitely. The exact quantities will vary on a case-by-case basis.

Figure 11 shows not only existing character (year 0) and desired character (year 200 and year 300) but also the intermediate steps and time periods necessary to achieve the balance of size and age class over time.

The conversion of a viewshed foreground to a managed state may start with a total old-growth stand situation as illustrated or a mixture of any of the other combinations.

Corridor viewshed planning may end at this point if scale of planning is broad. More detailed and site specific planning could utilize the following steps 9 through 11.

Step 9

Map the existing stands by size class.

The drawing is a plan view showing a segment of existing character at year 0. This same segment appears in the right side drawing to show its relationship to a management response unit (fig. 12).

Step 10

Divide the stands into cells of 10 to 30 acres. Select the cells to be moved to their next size class. The map at year 50 shows 20 per cent of the foreground moved through regeneration seedling-sapling stage in the 10- to 30-acre size cells shown as 1 sh and cc. The cells are distributed throughout the foreground by design but collectively represent the 20 per cent shown in the diagram.

Step 11

Treatment in this illustration to accomplish the year 50 regeneration seedling-sapling character is done each decade in small increments which make up 20 per cent of a cell. An example of one of these increments is shown in white. At year 50, treatment of the total cell will be complete. Management control of the small treatment areas is done by desired percentages of each cell. The 10-to 30-acre cells, however, are mapped and monitored over time.

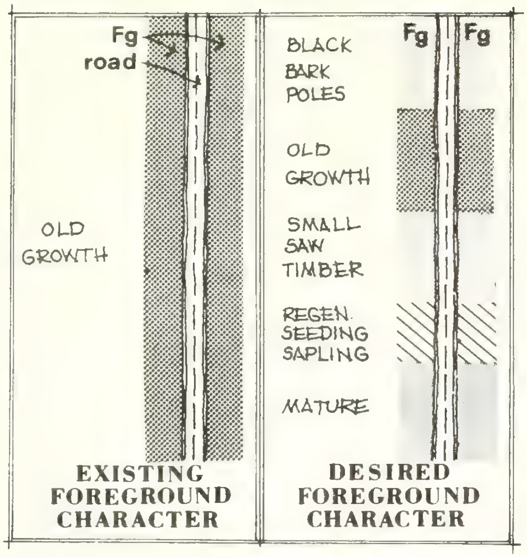

Figure 10--Existing foreground vegetative characteristics.

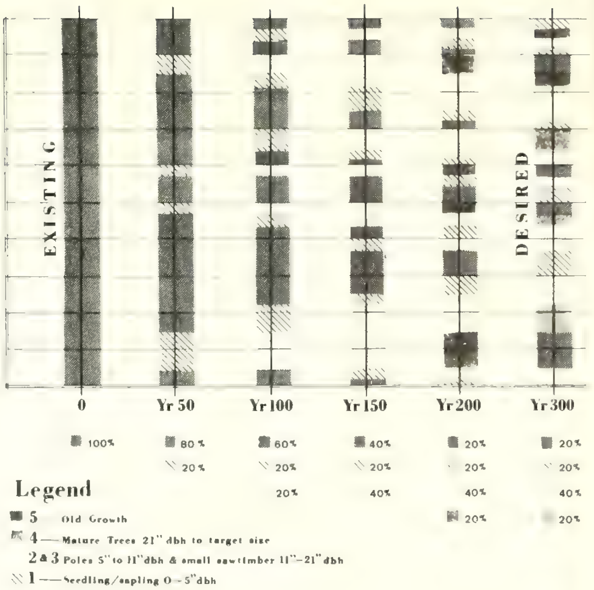

Figure 11--Existing and desired character.

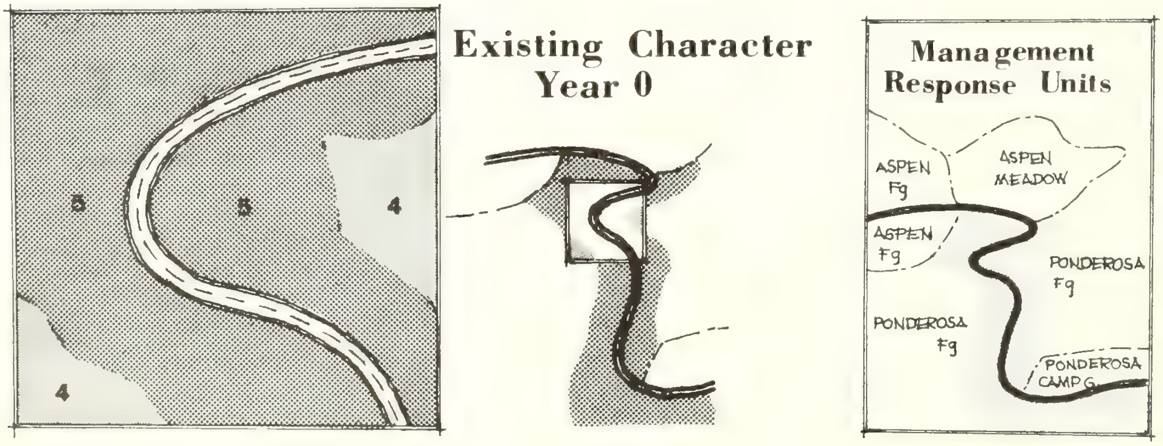

Figure 12-- Plan view showing a segment of existing character at year 0, and its relationship to a management response unit.

Development of such a conceptual silvicultural and visual process is usually about where corridor viewshed planning ends for foreground ponderosa pine and project design begins. The section on ponderosa pine describes development of landscape design criteria and silvicultural treatment concepts to achieve corridor viewshed direction.

SILVICULTURE TREATMENT CONCEPTS

Design Criteria
Ponderosa Pine foreground

Landscape design criteria developed from biological capabilities, desired visual sequence, visual quality objective RETENTION, associated resource objectives and used to guide silviculture treatments include:

1. Maintain large 26- to 36-inch diameter open park-like stands in 20 per cent of foreground.

2. Maintain old-growth characteristics of yellow-plated bark with deep fissures.

3. In regenerated areas maintain a combination of small openings contrasted against areas of dense reproduction irregularly spaced (clumpy) leave trees.

4. Precommercial thinning should be done so that it appears clumpy and irregularly spaced. Avoid leggy appearance of saplings.

5. In the black bark stage, create diversity in density and tree diameter. Contrast against yellow-bark stands and areas of reproduction where possible.

6. On each acre, in each character situation described, maintain three to five trees per acre to grow on to extra large trees and provide a few wildlife snags per acre for cavity nesters.

7. Stumps, debris, skid roads, and other negative visual elements should not be evident as viewed from the highway by a vehicular-oriented observer.

Treatment Concepts

Discussion of treatment concepts to meet design criteria and corridor viewshed direction begins with an enlarged drawing of the treatment increment within the cell drawing previously shown.

RETAIN SIZE CLASS 4 (MATURE STAND) or 5 (OLD GROWTH) The goal may also be to create it. The objective is to retain the desired mature or over-mature character until the cell is ready to be regenerated.

CREATE SIZE CLASS 1 sh (Stands in the process of being regenerated by shelterwood) from size 4 or 5.

The objective is to alter the density of the mature stand sufficiently to start regeneration, yet retain or create special enhancement effects, such as increased visual penetration into the stand at the time of the seed cut. As regeneration becomes established, either naturally or by planting, the open character will be replaced by rather dense but clumpy stands of reproduction. Small clearings sufficient to enframe or feature large trees will be created or retained. Varying densities in the clumps will provide screens to avoid continuous deep visual penetration.

CREATE SIZE CLASS 1 cc (Stands in process of being regenerated by patch clearcut) from size 4 or 5

The objective is to create and maintain natural appearing open spaces. Creating such spaces is accomplished as described below in each Visual Quality Objective. Maintaining open space quality is accomplished by controlling density of planted or natural regeneration to 50 to 70 trees per acre. If this is maintained, commercial thinning should be unnecessary or at least much reduced. The open spaces are most effective when displayed against the areas of reproduction occurring a decade or two after the shelterwood seed cut.

Example Treatment - Retention

Retain 12 to 15 shelter trees per acre, in clusters of 3 to 5 trees within a 50-foot diameter circle. Trees with the yellowest bark should be selected for shelter trees. The area influenced by these clusters should cover 75 percent of the subunit which is being regenerated and achieve a density of 300+ seedlings per acre within a decade.

Example Treatment - Retention

The treatment area or subunit should consist of openings ranging in size from about one quarter acre to about one acre, with natural or planted stock of 50 to 70 trees per acre. Areas with this stocking level should make up the remaining 25 per cent of the selected original mature stand.

CREATE SIZE CLASS 1 ss (Stands in need of pre-commercial thinning derived from the shelterwood regeneration harvest)

The objective is to thin the stands resulting from both the shelterwood and clearcut harvest activities, before the trees' lower branches die. Thinning spacing should vary considerably to give a natural appearance and add visual depth into the treated area. Pre-commercial and initial thinning entries may be completed for the most part during the same 50-year conversion period as the regeneration cutting, and will probably occur in approximately the same order of entry.

Example Treatment - Retention

Precommercial thinning will be required when the live crown ratio of crop trees falls below 85 per cent or the average stand diameter reaches 4-inch DBH.

The initial precommercial thinning entry should reduce the average stand density to 300 stems per acre (note: interplant up to 180 TPA). When the stand reaches a crop tree average of 6-inch DBH, density should be reduced to 180 stems per acre if a market does not exist for 6-inch DBH material. The remaining shelter trees should appear as scattered singles. Of the five remaining shelter trees, three may be converted to snags during the following 150 years, both for aesthetics and wildlife needs. This conversion would be unnecessary if adequate snags are already present. The two remaining shelter trees may be left to die a natural death after filling the need for a few very large trees with old-growth character.

CREATE SIZE CLASS 1 ss (Stands in need of precommercial thinning derived from small clearcuts)

By design, the stocking established in small clearcuts should be much sparser, to retain the open feeling of the unit; spacing should be widely varied to appear natural. This tends to produce additional contrast with surrounding, more heavily stocked areas. Such contrast is desirable.

To meet this objective in the same ponderosa pine stand, the technique described below might be prescribed.

Example Treatment - Retention

Areas from the small clearcut situation should be precommercial thinned 2-inch DBH crop tree size, or fill-in planted, as necessary to provide an approximate density of 50 to 70 trees per acre. Areas treated in this manner will reach conditions described in the mature situation (open and park-like) earlier than the shelterwood treatment. The use of fire or power saws may be necessary to create and continue to mature stand (open and park-like) characteristics.

Necessary planting or thinning should be done to retain the open feeling of these small units. This would be achieved if crowns range from 3- to 12 feet apart in a random pattern.

CREATE SIZE CLASS 2 and 3 (Stand eligible for commercial thinning)

As treatment areas within a stand approach this size class, their appearance tends to become more uniform, with a resulting decrease in contrst and diversity. In ponderosa pine, the predominant visual effect of such a stand is the appearance of line in black bark trees. Visual diversity is caused primarily by the varying densities and diameters of trees. The objectives should be to maintain this diversity as much as possible.

Example Treatment - Retention

These are stands exceeding an average 6-inch DBH, with a density greater than the recommended stocking level. Three or four commercial thinning entries are anticipated to reach a crop tree average of 16-inch DBH. An additional thinning entry will be needed near maturity. Commercial thinning should be accomplished in all portions of the stand before the stand density reaches a level that diameter and height growth is badly restricted.

Commercial thinning should reduce stand density to within ± 10 per cent of the recommended stocking. It should also maintain a diversity of spacing and diameter size. Diameter size diversity can be achieved approximately by varying leave tree diameters to ± 25 per cent of the average stand diameter. Variety of tree size will be achieved by the natural growth rate differences of individual trees. Commercial thinning should be accomplished in varying densities, creating contrast with the nearest similar portion. The last commercial thinning entry will be scheduled at approximately 26-inch average DBH, as stand enters Group 4 characteristics.

Spacing should vary from 15 to 50. Trees with minimum spacing should have maximum open spaces on at least two sides.

The Role of the Landscape Architect in Applied Forest Landscape Management: A Case Study on Process[1]

Wayne Tlusty[2]

Abstract: Land planning allocations are often multi-resource concepts, with visual quality objectives addressing the appropriate level of visual resource management. Current legislation and/or regulations often require interdisciplinary teams to implement planning decisions. A considerable amount of information is currently available on visual assessment techniques both for land planning and project implementation needs. Most literature does not emphasize the interdisciplinary process used to implement multi-resource activities. Processes which are overly complex in analysis or assessment technique commonly lack team commitment and therefore have limited useability. Also, processes in which team members are expected, or choose, to make strong recommendations outside their particular discipline are of questionable value, i.e., landscape architects making silvicultural and logging system recommendations.

INTRODUCTION

The Ant Hill proposed timber sale is on the Kootenai National Forest in northwestern Montana. This project provided an opportunity to bring several disciplines together and establish a successful process. This paper will address the project role of the landscape architect in landscape management. The emphasis is on the type of information a landscape architect can produce, when it is most meaningful and how the data can be appropriately used.

The Ant Hill sale area covered approximately 5000 acres and had a current land management plan. Most of the study area (figure 1) was viewed from Lake Koocanusa, a 98-mile reservoir and both a state highway and forest development road. The principle resources within the study area were timber wildlife, and visual. Key discipline members involved were the silviculturist, wildlife biologist, hydrologist, soil scientist, loggoing engineers, presale foresters, civil engineers and landscape architects.

Figure 1. Ant Hill Study Area.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Extension Landscape Architect, Department of Landscape Architecture, University of Wisconsin, Madison, Wisconsin.

PROJECT PROCESS

The intent of this paper is to address only the more significant landscape management contributions and will therefore greatly abbreviate the intensive study, documentation and recommendations of related resources.

Figure 2 shows the major steps involved in the case study. The interdisciplinary team did not start with this as a predetermined timber sale process. But, when the project was implemented and reviewed, the sequence followed was as illustrated in figure 2.

Step 1--The study area was part of the Warland Planning Unit (U S D A Warland) and contained portions of seven different management units. Each specific management unit had a resources management objective, (fig 3) and contained basic management guidance.

Step 2--Most timber sale activities are guided by a 5 year timber harvest plan. This is a functional resource management plan which is responsive to the land management plan and is updated annually.

Step 3--This involves an intensive inventory and analysis phase. During this step the resources do not interact beyond determining appropriate mapping levels and how the data will be used. Figure 5 displays the optimum logging system as dictated by site conditions. In this study over 150 on-site, slope profile elevations were taken to be later converted into accurate graphic profiles, by using a digitizer, desk top computer and plotter. The profiles allow accurate deflections to be determined and analyzed for logging systems and associated roading.

The stand map, figure 6, shows areas which were inventoried for site data of slope, aspect, elevation, landform, geology, soils, climate, habitat type and relative productivity. The stand data also includes species composition, stand structure by age and size classification, density stand history, successional trend, tree crown condition, growth rates, timber volume. Understory vegetative conditions are also recorded.

Wildlife species to be managed for were identified. In the case study area, the browse and cover conditions for big game winter range was inventoried and mapped.

The landscape architects established visual criteria and support data for the landscape's Visual Absorption Capability (VAC).[3] Slope, observer distance, aspect relative to observer, landscape complexity, frequency viewed, and vegetation condition were inventoried. An overlay for the VAC map was developed showing the prominent features of primary

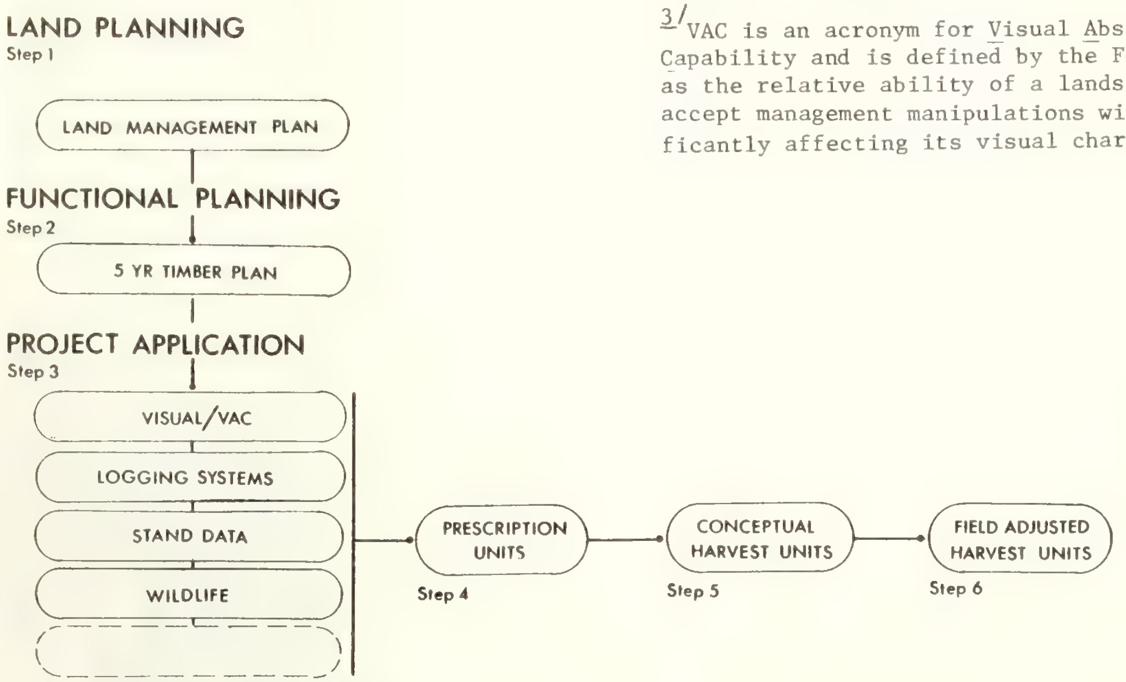

Figure 2-- Schematic of Ant Hill case study process.

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[3] VAC is an acronym for Visual Absorption Capability and is defined by the Forest Service as the relative ability of a landscape to accept management manipulations without significantly affecting its visual character.

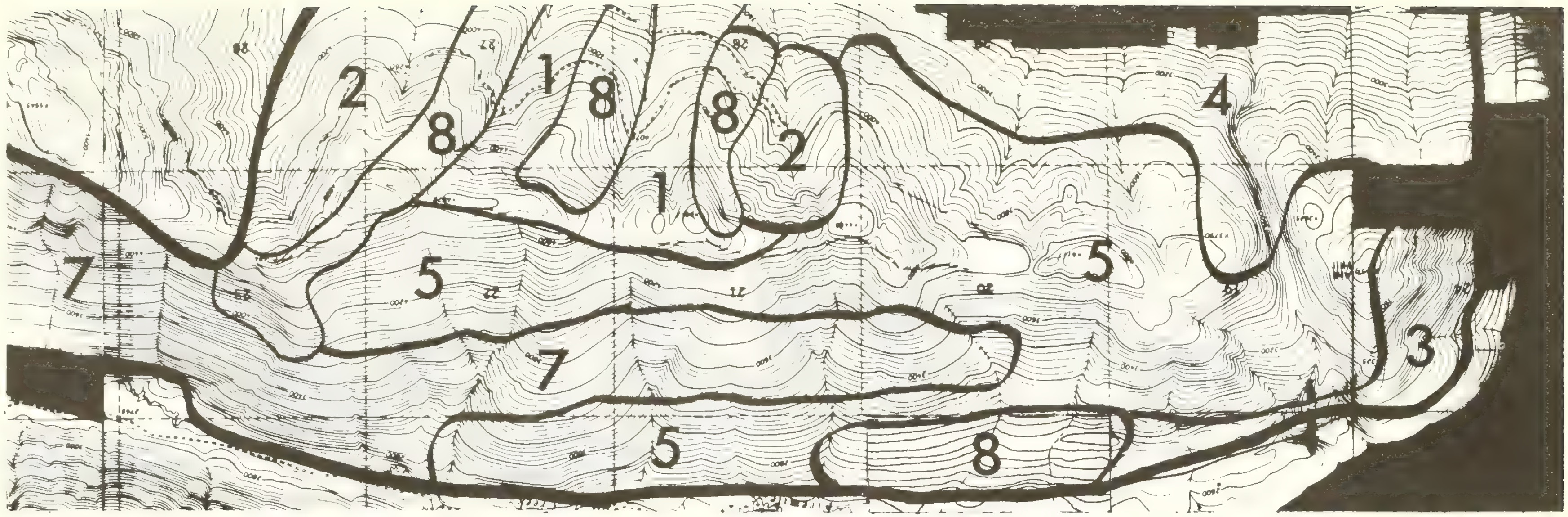

Figure 3 LAND MANAGEMENT PLAN. A portion of the Warland Planning Unit. Land Management units with major management emphasis are: #1 - (no major resource emphasis), #2 - Timber/Visual (Maximum Modification) resources, #3 - Recreation/Visual (Retention) resources, #4 - Wildlife (winter range)/Timber/Visual (Partial Retention) resources, #5 - Timber/Visual (Partial Retention) resources, #7 - Timber (by advanced logging systems/Visual (Partial Retention) resources and #8 - Timber/Visual (Modification) resources.

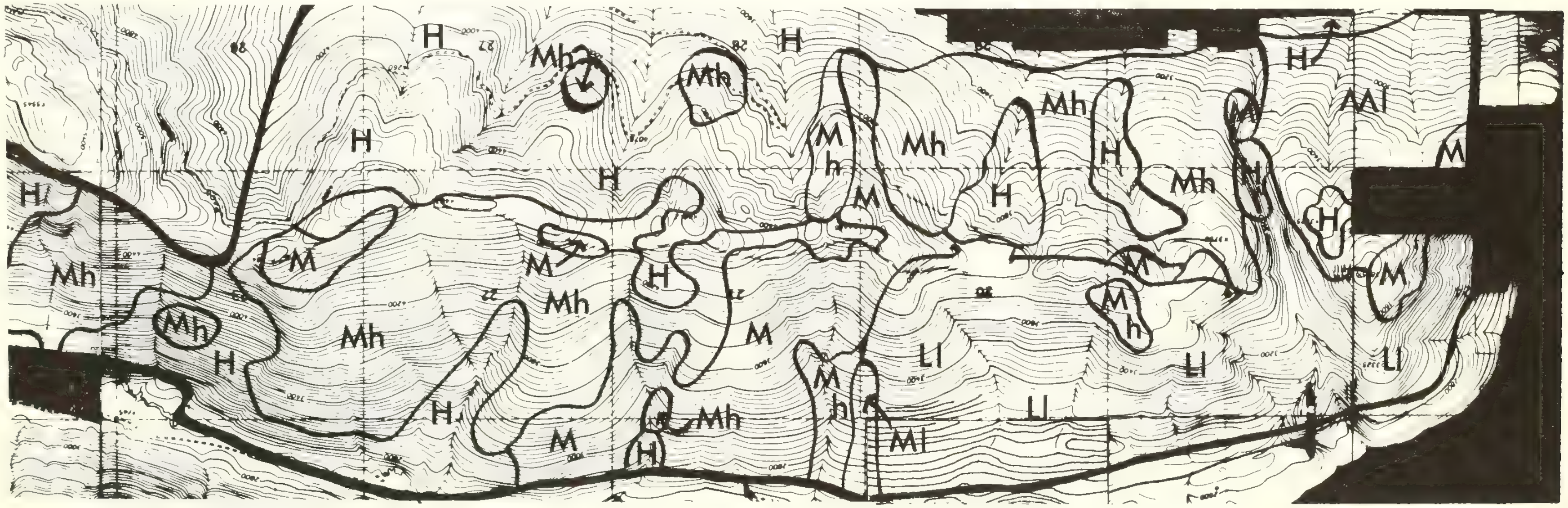

Figure 4 VAC MAP. Using both physical and perceptual factors, the study area was stratified into units based on the relative ability to absorb clearcut logging and associated roading practice. Ll = low and least ability to absorb impacts, Ml = moderately low ability, M = moderate ability, Mh = moderately high ability, and H = areas which are not seen from significant viewing positions.

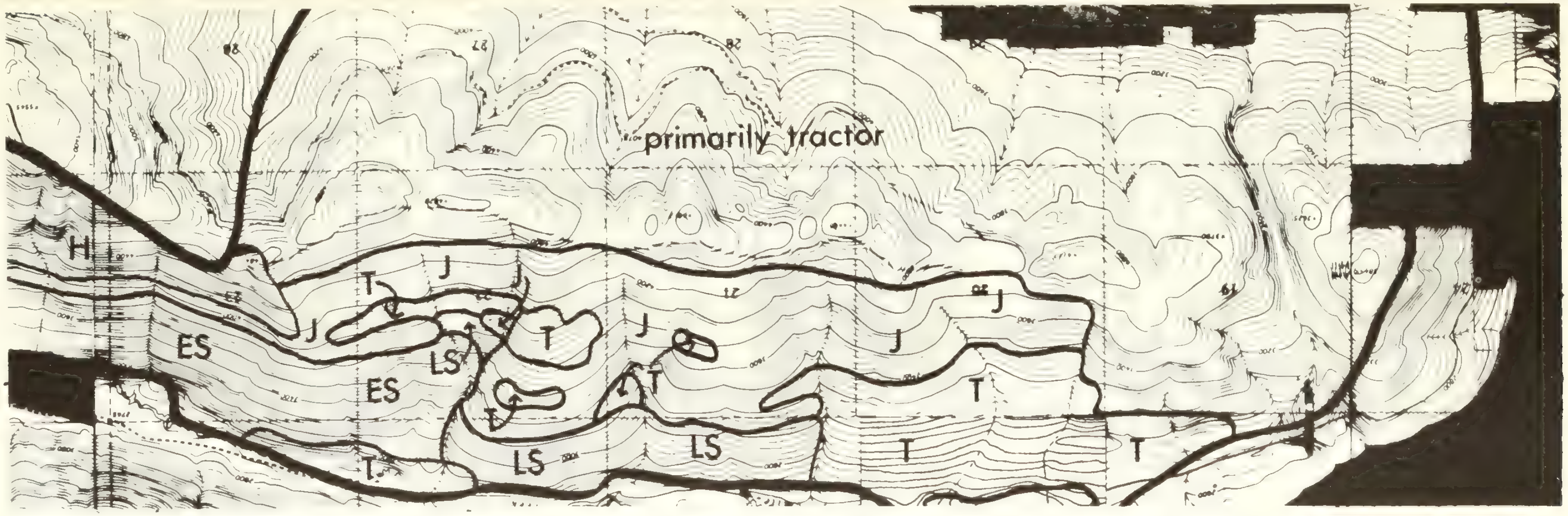

Figure 5 LOGGING SYSTEMS. Proposed logging systems with estimated yarding distances (EYD). T = tractor (EYD=1800'), J = jammer and running skyline (EYD 900'), LS = live skyline (EYD 1500'), ES = European downhill skyline (EYD 5000') and H = helicopter (EYD 6000').

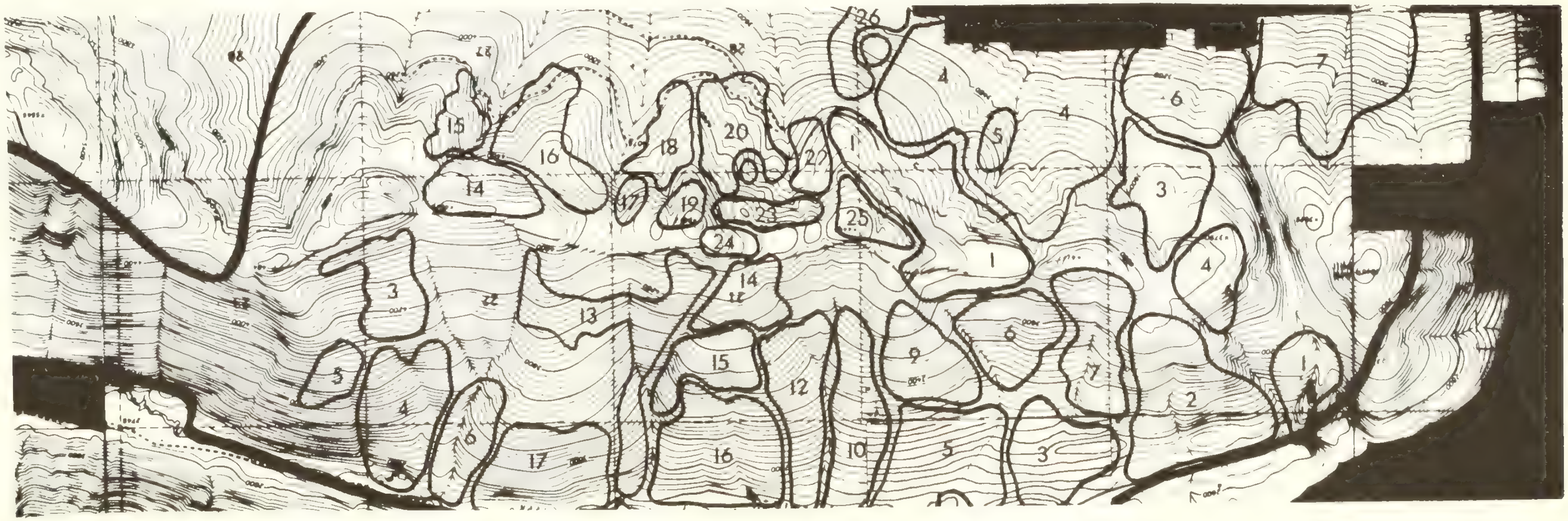

Figure 6 STAND MAP. Areas of similar vegetative condition and site characteristics.

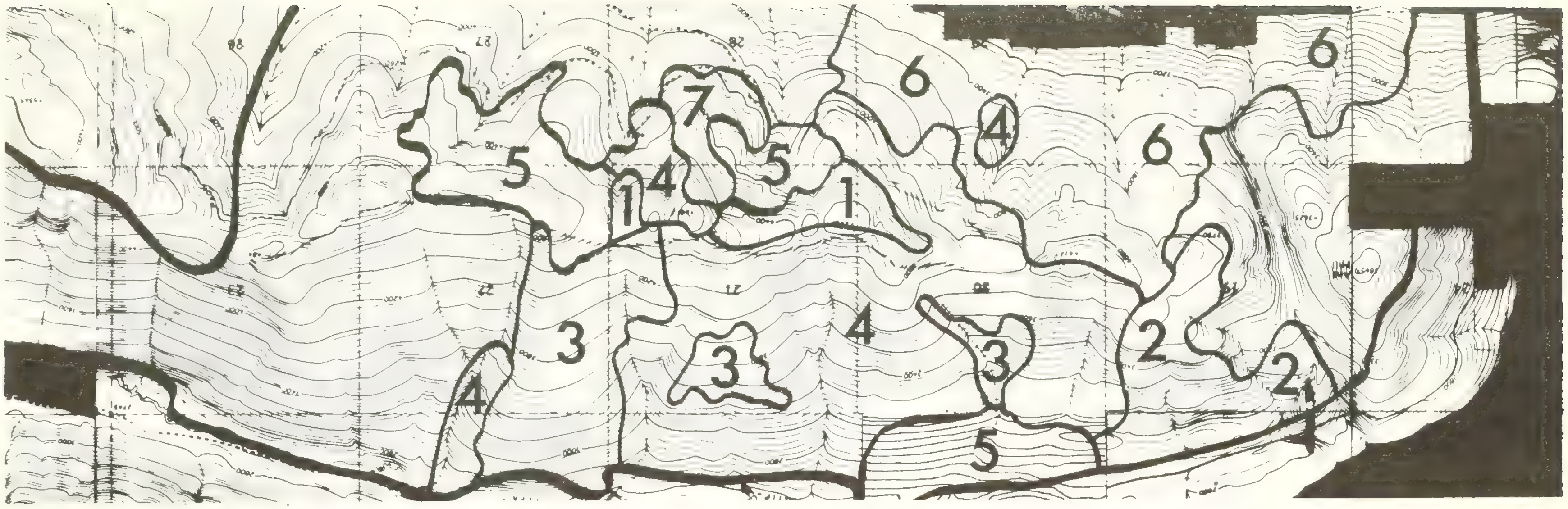

Figure 7 SILVICULTURAL PRESCRIPTION UNITS. Response units which have similar land management objectives and biological conditions. Each unit has a specific vegetative treatment prescribed.

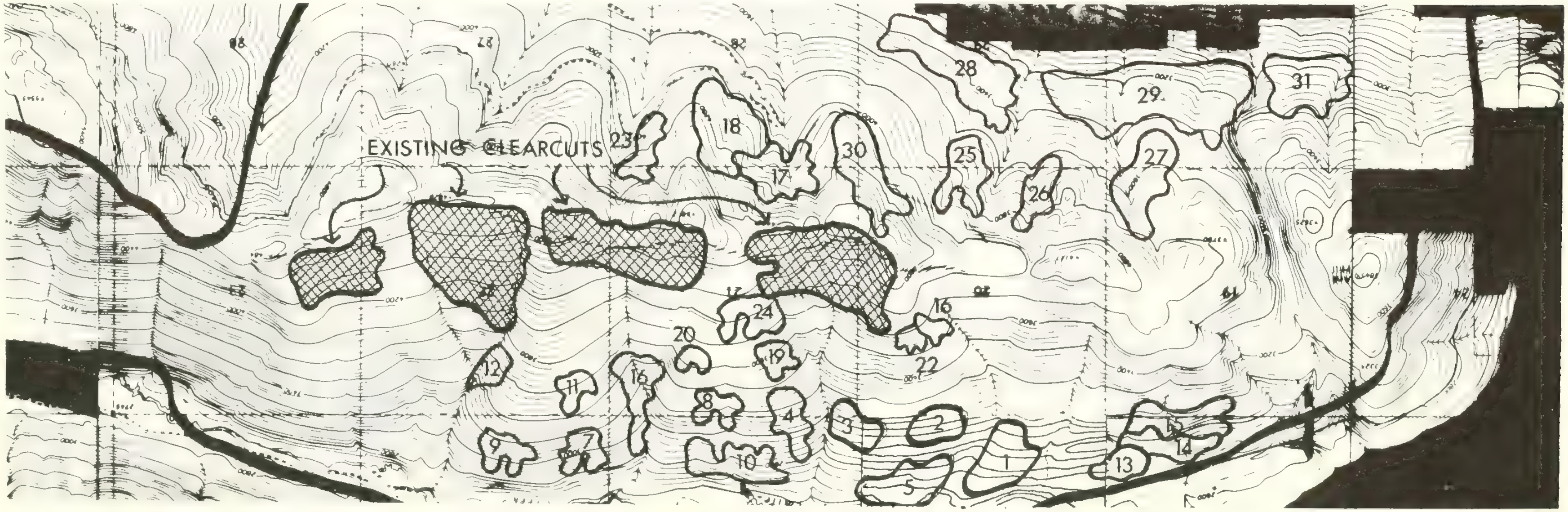

Figure 8 PROPOSED SALE LAYOUT UNITS; WITH TREATMENTS. Units 13, 14, 15 will have single tree selection, Units 7, 9, 11, 12, 16, 25, 26, 27 will be clearcut, Units 28, 29, 31 will have small group selection, Units 1, 2, 5, 17, 18, 30 will have a shelterwood treatment, Units 3, 4, 6, 8, 10, 19, 20, 22, 23 and 24 will have a two-stage shelterwood harvest.

ridges, secondary ridges, focal points, existing clearcuts, natural openings, and areas with critical soil problems (Hilliard et al. 1977)

The inventory data were analyzed and the criteria were weighted both internally and externally. The study area was stratified into five visual absorptive levels and mapped (fig. 4). The VAC map displayed the relative ability of the landscape to absorb clearcut timber harvest and associated roading. Each of the five absorptive levels had landscape management guidelines (Hilliard et al. 1977) developed for: timber harvest and associated roading, management implications and priority and accuracy of field layout control for landscape design techniques. Minimum recommendations were also offered for landscape rehabilitation and establishing desired visual character for the viewshed.

The VAC map, with accompanying guidelines, was used in developing silvicultural response units, silvicultural prescriptions, road location and screening, and conceptual harvest unit size, shape and distribution. It should also be noted that the large land management areas with the visual quality objective of partial retention (fig. 3) show considerable differences in the ability of the landscape to absorb clearcuts.

Step 4--Figure 7 displays seven prescription units. These units were delineated using stand, wildlife, logging system and VAC map composits which relate to the land management objectives. Unit boundaries were established using both biological and visual data. Selected excerpts (Underwood 1977) from four of the prescription units (fig. 5) are included to demonstrate how the visual quality objectives and VAC map information were incorporated into the prescription treatment process.

Prescription Unit-2 (Figure 9)

This unit is unique due to the past management activities leaving the stands with three separate age classes and a variety of size classes. With this in mind and considering the very high viewing considerations, selection regeneration is the objective.

Proposed Treatment: Continue the uneven age stand structure by utilizing the individual tree selection system. This will meet the Visual Quality Objective and Silvicultural objective by maintaining the regeneration process already occurring. Maintaining or increasing the age class components will be the long range goal for this. A marking guide is attached for stand 6.1-02 utilizing Stage 1 stand structure data. This plan develops the marking by diameters class necessary to maintain the present stand structure and develop opportunities for creating additional size classes (Underwood 1977).

Stand 606.1-2
Present BA=134 ft.^{2}
Stand Structure
Residual 70 ft.^{2}
Correction Factor $\frac{70}{134} = .52$

EXISTING TREES

Diameter (Inches)	Number of Trees
1	107
2	43
3	64
4	21
5	64
6	63
7	39
8	19
9	36
10	16
12	15
14	7
16	12
18	5
25	8
25+	3

RESIDUAL TREES

Number of Trees	
56	
22	
33	
11	
33	208 leave trees
33	at 14.5 x 14.5 ft.
20	
10	
19	35 ft. spacing
8	
8	
4	60 ft. spacing
6	
3	70 ft. spacing
4	
2	85 ft. spacing
64 Merchantable per acre leave	

Figure 9--Existing and Proposed Size Classes.

Prescription Unit-3 (Figure 7)

"All stands are in need of regeneration, therefore the regeneration process should begin utilizing the clearcut or seed tree system.

Proposed Treatment: Begin the regeneration process through the use of clearcutting or the seed tree regeneration system. Clearcuts should be small, 5 to 10 acres, with irregular edges to give the units a more natural appearing shape. One stand had a Visual Absorptive Capability (VAC) mapping class of L1 (low), least able to absorb management activities [first entry]. Harvesting should begin at the top of this stand, working down slope during future entries. A screening effect of the road at the bottom of the cutting unit will occur if harvested in this manner. Other stands had less viewing significance when VAC mapped, therefore clearcuts can be larger, 15 to 20 acres. Irregular edges are also necessary in these units to appear more natural"(Underwood 1977).

Prescription Unit-4 (Figure 7)

"All stands are in need of regeneration therefore the regeneration process should begin by utilizing the shelterwood system. This regeneration system will meet the variety of land management objectives included in this unit. The shelterwood system, leaving approximately 35 trees per acre and 50 ft. BA/Acre should meet partial retention Visual Quality Objective. This system would introduce new line, color, and texture but should remain subordinate to the landscape.

Proposed Treatment: Begin the regeneration process through the use of a shelterwood regeneration system [first entry]. Leave tree marking should be done with a 35' x 35' to 40' x 40' maximum spacing. Preferred species are: Douglas-fir and western larch on the north aspect and ponderosa pine, Douglas-fir and western larch on the south aspect.

Attempts should be made to feather the edges of cutting units on the north slope rated as L1 (low), on the Visual Absorption Capability mapping. This can be accomplished by marking more leave adjacent to cutting unit boundaries.

Removal of the leave trees [will be] after regeneration is complete and acceptable stocking levels reached of at least 400 desirable stems per acre. [The removal] should be scheduled to meet the VQO and timber production considerations. Areas mapped by the Visual Absorption Capability and having a L1 (low) rating, least able to absorb management, should have a two stage leave tree removal established. Approximately 1/2 of the [thirty-five] leave trees should be removed [in a second entry] approximately 8 to 10 years after regeneration began. This should leave approximately 13 to 17 [trees] per acre. The remaining trees should be removed within 5 to 8 years after the first [shelterwood] removal, [this would be the third entry]. Areas VAC mapped with more ability to absorb management activities should have the leave trees removed in one operation, but should be 10 to 12 years after regeneration began, depending on the site's VAC rating." (Underwood 1977)

Prescription Unit-6 (Figure 7)

"Improve the key winter game range cover/opening ratio through the use of various silvicultural systems such as individual tree selection, group selection, clearcutting, and liberation (overstory removal). While performing these cutting methods, the Visual Quality Objective must be followed.

Proposed Treatment: Areas below 3500' elevation will be managed primarily for white-tail deer. Areas above 3500' to 3800' will be managed for mule deer and elk.

In the white-tail area, develop large cutting units creating a mosaic of openings and marking individual trees for harvest. Small, 1/2 to 3 acre, clearcuts should be marked in areas containing concentrations of larch; preferably high risk concentrations. These small clearcuts should be interspersed with uncut areas of cover providing security and thermal cover. Additional marking should occur outside of the designated small clearcuts. In these areas mark high risk western larch, Douglas-fir and ponderosa pine for cut.

In the mule deer-elk areas, larger clearcuts should be designated in the 20 to 30 acre class, as these animals prefer larger openings interspersed with security and thermal cover areas. Three to four hundred feet of cover should be maintained between clearcuts. By creating irregular boundaries on the clearcuts, the VQO should be met.

The visual absorption capability (VAC) mapping classified the area designated for larger clearcuts as Mh or H. Mh is moderately to moderately high in the ability to absorb management activities and H is not viewed from critical viewpoints. An attempt should be made to locate clearcuts in the H area.

The recommendations set forth in the "Guidelines for Coordinating Timber Sales With Big Game Winter Range,"[4] Kootenai National Forest, were followed." (Underwood 1977)

The VAC map (figure 4), provided the silviculturist with site specific, visual information. Where biological options allow either shelterwood or clearcut practices, the silviculturist could write a prescription for shelterwood harvest in the units with higher visual quality objectives and low VAC levels. Areas with a shelterwood harvest and in low VAC areas required two entries to remove the shelterwood leave trees. Prescription units with high visual quality objectives and high VAC levels, could have clearcuts prescribed; if the visual portion of the land planning objective could be met. Areas which biologically require clearcut or seedtree practices and have a high visual quality objective and low ability to absorb could still have these regeneration practices used but with small scale landscape design techniques used to control visual impacts.

The landscape architects used the silvicultural prescription reports, VAC map and visual quality objectives to test prescriptions for visual compliance. Initial landscape design strategies were developed, i.e., size and distribution concepts in clearcut areas, number of leave trees in shelterwood areas, recommended height of regeneration before shelterwood removal, screening requirements for roads, foreground species compositions.

Step 5--Presale personnel used the logging systems map (figure 5), wildlife guides, silvicultural prescriptions (figure 7), and the VAC maps (figure 3) to develop conceptual harvest units. They worked with the landscape architects in the areas with higher visual quality objectives and low VAC ratings. Landscape design techniques along with Perspective Plot (Twito 1978) were used to test and adjust seed-tree and clearcut units.

Step 6--Conceptual harvest units were tested in the field. By using the VAC map (figure 4), presale personnel know which units, for visual reasons, require the most accurate layout control. Perspective Plot provided accurate information on the actual size, shape, critical edge, and screening situations. The VAC map also suggested where presale personnel should involve the landscape architects in needed field adjustments to harvest units. Figure 8 shows the final harvest unit configuration.

RESULTS

The following conditions seem to best explain why the Ant Hill project was a successful process; at least in the project application phase.

1. All members were well-qualified and trained in their respective positions, i.e., certified silviculturist, personnel with advanced logging systems training. Well trained personnel provided creativeness and more implementation options rather than resorting to traditional concepts.
2. A high degree of interdisciplinary credibility was present within the team and recognition by team members of the visual resource as a legitimate "resource" to be managed, and not just be mitigated.
3. The VAC map provided direct assistance to the silviculturist and presale foresters.

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[4] Guidelines were developed for the winter range of seven species of big game. Nine topics were addressed which related to vegetative manipulation; this includes silvicultural methods and size of cutting units. The wildlife biologist and landscape architect developed guidelines which would resolve conflict between high visual quality objectives and big game winter range. In areas of retention and partial retention, with low ability to absorb (VAC), the lower size suggested big game vegetative management option of clearcutting or seedtree harvest would be used. As the landscape's ability to absorb increases and/or visual quality objectives become lower, the suggested game harvest sizes increase to the larger recommended sizes.

4. The use of Perspective Plot (Twito 1978) to test layout concepts, offered design credibility through accuracy.
5. Landscape architects were able to provide accurate and meaningful data at various stages of the process.
6. Figure 8 includes several existing clearcuts which are more than 60 acres in size. These units were designed in about 1968. A comparison between the old and new proposed harvest units would suggest there are more biological opportunities to meet a variety of multi-resource needs than formerly displayed.

The process shown in figure 2, could be improved by using current concepts in two areas. Viewshed planning (U S D A Landscape Management) would logically precede the visual recommendations in project timber sale planning. A new computer program, "Scope" (Nickerson 1977), would be used to test concepts of shelterwood harvest. Figure 10 shows an update of the schematic process (fig 2) and could serve as a base from which to develop a local, specific, project process for landscape architects involvement in applied forest landscape management.

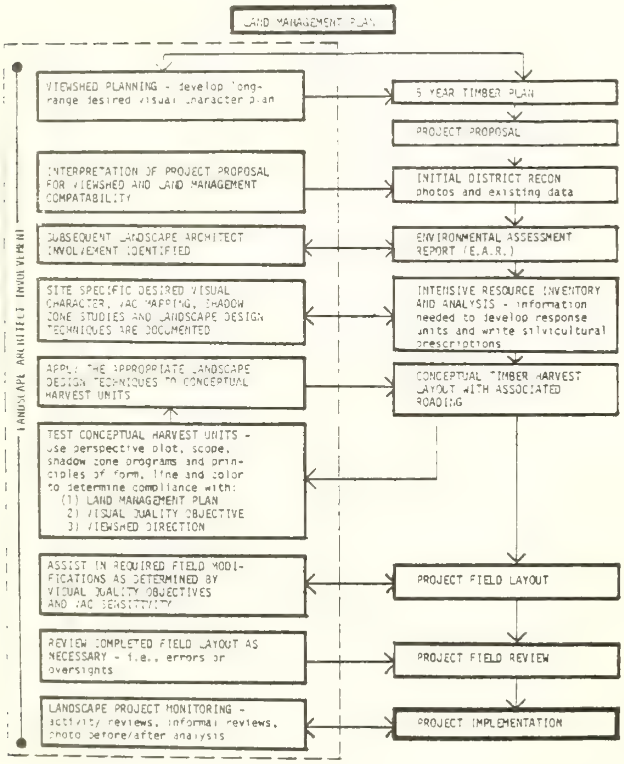
LAND MANAGEMENT PLAN
LANDSCAPE ARCHITECT INVOLVEMENT
VIEWSHED PLANNING - develop long-range desired visual character plan
INTERPRETATION OF PROJECT PROPOSAL FOR VIEWSHED AND LAND MANAGEMENT COMPATABILITY
SUBSEQUENT LANDSCAPE ARCHITECT INVOLVEMENT IDENTIFIED
SITE SPECIFIC DESIRED VISUAL CHARACTER, VAC MAPPING, SHADOW ZONE STUDIES AND LANDSCAPE DESIGN TECHNIQUES ARE DOCUMENTED
APPLY THE APPROPRIATE LANDSCAPE DESIGN TECHNIQUES TO CONCEPTUAL HARVEST UNITS
TEST CONCEPTUAL HARVEST UNITS - use perspective plot, scope, shadow zone programs and principles of form, line and color to determine compliance with:
(1) LAND MANAGEMENT PLAN
2) VISUAL QUALITY OBJECTIVE
3) VIEWSHED DIRECTION
ASSIST IN REQUIRED FIELD MODIFICATIONS AS DETERMINED BY VISUAL QUALITY OBJECTIVES AND VAC SENSITIVITY
REVIEW COMPLETED FIELD LAYOUT AS NECESSARY - i.e., errors or oversights
LANDSCAPE PROJECT MONITORING - activity reviews, informal reviews, photo before/after analysis
5 YEAR TIMBER PLAN
PROJECT PROPOSAL
INITIAL DISTRICT RECON photos and existing data
ENVIRONMENTAL ASSESSMENT REPORT (E.A.R.)
INTENSIVE RESOURCE INVENTORY AND ANALYSIS - information needed to develop response units and write silvicultural prescriptions
CONCEPTUAL TIMBER HARVEST LAYOUT WITH ASSOCIATED ROADING
PROJECT FIELD LAYOUT
PROJECT FIELD REVIEW
PROJECT IMPLEMENTATION

Figure 10--Suggested process for landscape architect involvement. This would be modified to meet specific project impact and sensitivity needs.

SUMMARY

Landscape architects currently have the needed techniques to practice intensive landscape management. They must now develop realistic and meaningful processes, which allow accurate visual impact and enhancement assessments to become fully useable. Professional judgments, which are not defensible, have limited value. The more landscape architects can not only predict, but clearly state desired visual situations, the sooner they will move from the positions of visual critics and/or visual impact mitigators, to areas of more effective visual resource management.

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A System to Program Projects to Meet Visual Quality Objectives[1]

Fred L. Henley and Frank L. Hunsaker[2]

Abstract: The U. S. Forest Service has established Visual Quality Objectives for National Forest lands and determined a method to ascertain the Visual Absorption Capability of those lands. Combining the two mapping inventories has allowed the Forest Service to retain the visual quality while managing natural resources.

The management of lands to meet or retain visual quality appears to most as a collection of conflicting words and methods. However, if one analyzes it the following thoughts emerge: Timber harvest entails the removal of a part of the landscape (fig. 1); to retain implies to hold or restrain (fig. 2); a landscape just by the natural order of things is continually changing due to natural germination, growth, and death (fig. 3). Thus, combining the natural succession process with carefully introduced management we have the opportunity to retain the character which gives a landscape its visual quality.

The U. S. Forest Service is charged by the public through Congressional acts and laws to remove timber and yet maintain the visual qualities of National Forest lands. This charge, although probably implied or assumed

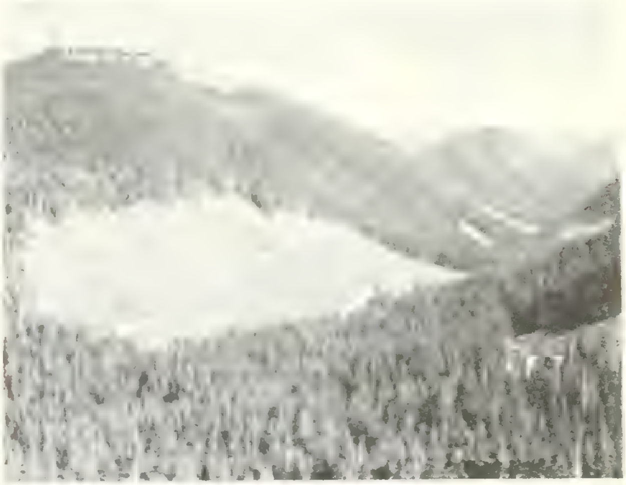

Figure 1--An example of an area where timber has been removed.

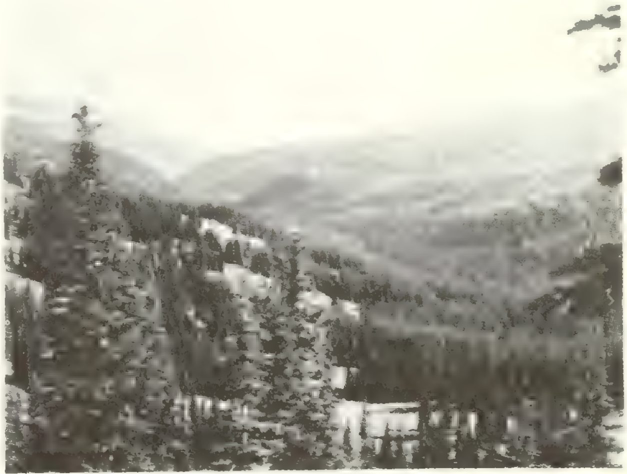

Figure 2--An example of a landscape where visual quality has been retained.

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[1] Presented at the Northwest Chapter meeting of the American Society of Agricultural Engineers, Spokane, Washington, October 19, 1978. Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] ASLA, Visual Staff Officer, Mt. Baker-Snoqualmie National Forest, Seattle, Washington; ASLA, Landscape Architect, Hells Canyon National Recreation Area, Wallowa-Whitman National Forest, Baker, Oregon.

by the public, was not fully met and led to controversy in the 1960's and is still somewhat of an issue-- Clearcutting controversies (fig. 4).

Figure 3--An example of natural attrition.

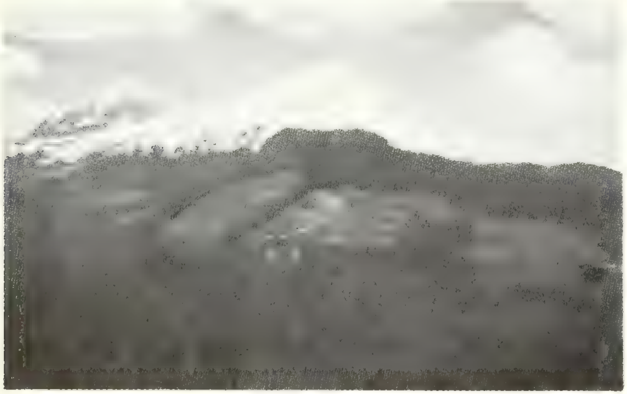


Figure 4--A more glaring example of an inappropriate clearcut on a sensitive landscape.

The National Environmental Policy Act (NEPA) of 1969 required all Federal agencies to manage and perpetuate scenic environments, among other things. It also required Federal agencies to develop methods and procedures to evaluate heretofore non-quantifiable elements, such as aesthetics.

The requirements of NEPA and the chance to continue timber harvest while retaining visual quality led to the development of the Visual Management System by the Forest Services.

This Visual Management System is based upon studies of landscape analysis that had been conducted in Scotland and Europe and were being explored by leading universities in the eastern United States, such as Harvard and the University of Massachusetts. The system is based upon data that have traditionally or historically been proven valid. The basis of the system is that all landscapes are identifiable and describable in objective terms. This type of work has been done in the past by geologists, ecologists and hydrologists and has been accepted. The basis of the Visual Management System is the geologic or geomorphic formations which make up each geologic province. These geologic forms are combined with the vegetative cover, water bodies and water courses found within each province (fig. 5). This geologic, vegetative, and water combination province is then broken down into three categories based upon variety described in terms of form, line, color and texture. The form, line, color and texture elements come from the arts and have been proven over time to be the elements in art or in landscapes that affect the eye, with form being the most dominant and texture being the least dominant.

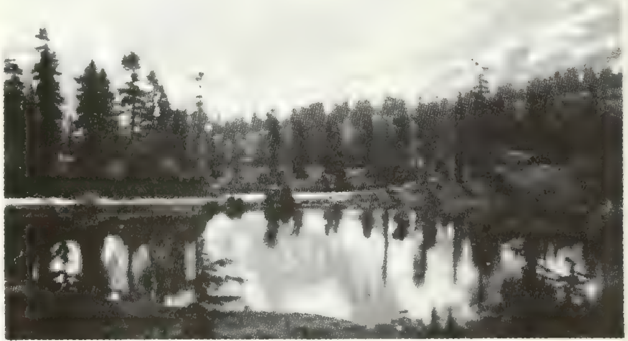


Figure 5--A vivid combination of land form, water body and vegetation.

The social importance of each landscape is then identified (fig. 6). This is done by determining (1) if the landscape is viewed by the public, (2) how many of the public view the landscape, and (3) how far the landscape

Figure 6--An example of social use of the landscape.

is from the viewer. The distance is rated in terms which again relate back to art. The method of presenting views through art has always been based and upheld historically in terms of foreground, middleground and background. In the physical landscape, the foreground extends from zero to one-half mile, the middleground from one-half mile to five miles, and the background from five miles to infinity.

After the social importance of the landscape is determined, then the variety of the landscape is compared to it and the amount of variety that could be manipulated is determined and described (figs. 7, and 8). The amount of manipulation is described in terms of retention of the variety, partial retention, modification or maximum modification of the variety. Contrary to what comes to most people's minds, maximum modification does not mean total manipulation. Rather, it means that man's manipulation of the landscape may be visible, identifiable, may dominate the landscape, but should borrow from the forms, lines, colors, and textures occurring naturally in the landscape.

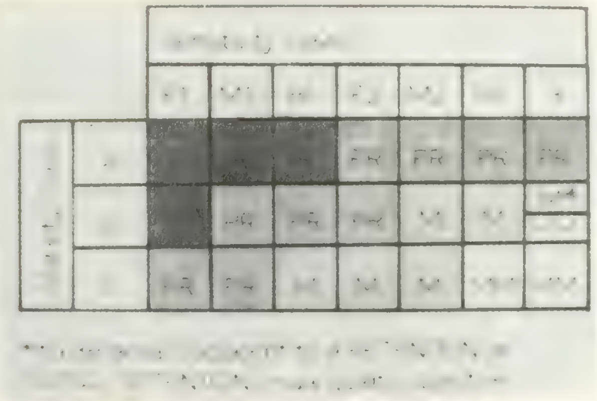
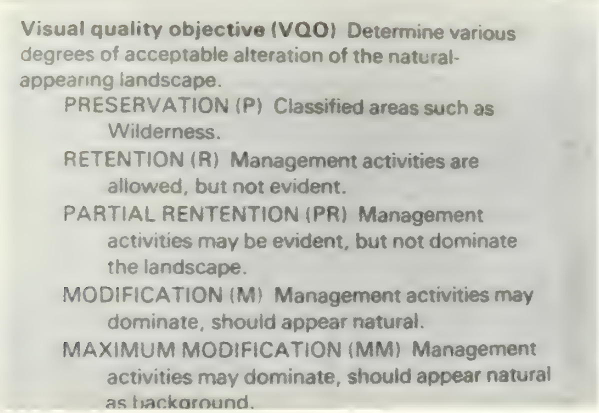


Figure 7--A matrix combining variety class and sensitivity level to yield management objectives.



Visual quality objective (VQO) Determine various degrees of acceptable alteration of the natural-appearing landscape.

- PRESERVATION (P) Classified areas such as Wilderness.
- RETENTION (R) Management activities are allowed, but not evident.
- PARTIAL RENTENTION (PR) Management activities may be evident, but not dominate the landscape.
- MODIFICATION (M) Management activities may dominate, should appear natural.
- MAXIMUM MODIFICATION (MM) Management activities may dominate, should appear natural as background.

Figure 8--Specification of visual quality objectives.

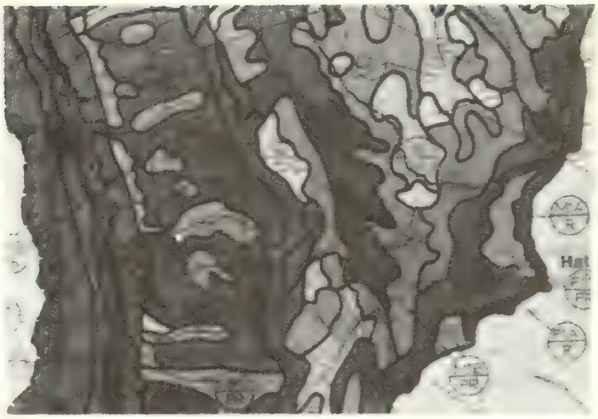


Figure 9--Geographic portrayal of visual quality objectives on maps.

All National Forest lands in Washington and Oregon have been identified and described with amounts of variety, and social importance determined, and visual quality objectives set. Each of the landscape factors combined with the visual quality have been mapped, graphically portrayed, and provided to each National Forest (fig. 9).

By having a geographic-vegetative zone or province as the base of a landscape inventory, we are able to recognize that the landscape flows beyond the man-imposed or administrative boundary of any one National Forest. Adjoining forests utilize the same description for the province, insuring that visual objectives relate to the same variety of elements. Thus, continuity of management should result within all visible landscapes.

However, a map showing landscape character, social importance, and visual quality (fig. 9), even when applied by a landscape architect, does not allow a land manager to estimate difficulties or cost of timber harvest while retaining visual quality. Recognizing this, the Forest Service is now refining the Visual Resource Inventory. This is being done by identifying landscape physical factors that affect the ability of that landscape to absorb man, his machines and influences. Here again, we go back to tried and tested data and factors that relate to geometry, art and physics.

For example, in geometry we learn that the closer a plane is to being perpendicular to us the more of the plane will be seen. In a landscape, the steeper the slope, the more man's manipulation or management will be visible. Another factor is that adjacent contrasting colors stop the eye. Thus, a very light subsoil, exposed through construction and adjacent to dark surface soil, attracts and stops eye movement. Dense vegetation screens and stops eye movement. Dense vegetation screens views, but open sparse vegetation allows relatively unrestricted views.

Combining physical and identifiable characteristics, such as those above, allows us to determine the ability of a landscape to absorb man's activities and management. This is known as the Visual Absorption Capability, or VAC, of the landscape. The lower the VAC, the greater the difficulty and cost of achieving the visual quality.

By now you recognize that to do a complete VAC analysis requires a great deal of detailed information. Applying this to a massive land base requires large expenditures of manpower and money, neither of which is available in vast quantities. To overcome this, the Forest Service is working on smaller selected land areas. These usually are corridors formed by roads, streams, or major trails. However, the eye does not stop at arbitrary administrative boundaries as it travels over a view. Thus the corridor must include all of the viewed lands referred to as the viewshed.

To understand how these systems, Visual Resource Inventory and VAC really work we need to look at a specific project such as the Nooksack River viewshed, located in the Washington Cascades within the Glacier Ranger District, Mt. Baker-Snoqualmie National Forest.

The Nooksack River, the northernmost river in northwest Washington, winds its way through a heavily timbered forest on its way to the Pacific Ocean via the Puget Sound (fig. 10). Several large glaciers and permanent snowfields are the primary source for the Nooksack and its tributaries. Elevations within the viewshed range from 950 feet to over 10,000 feet (figs. 11* and 12*). The valley floor varies from a few-hundred-feet wide to approximately one-mile wide. From the edges of the drainage floor the mountain slopes rise abruptly to the north, vary in the steepness of slope to the south, and are dissected by many drainages (fig. 13).

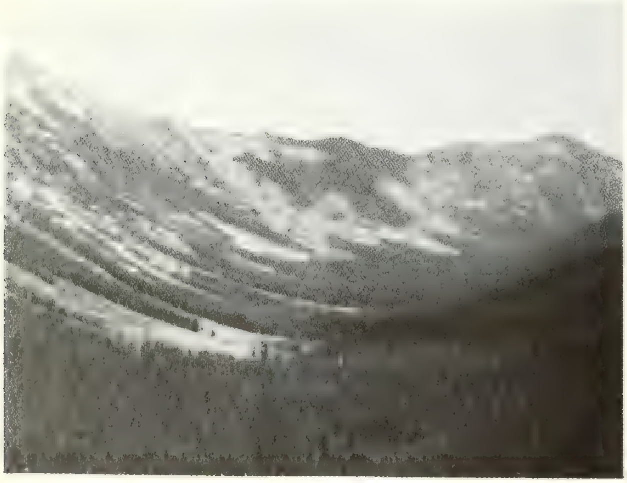


Figure 10--The Nooksack River valley.

The recreating public spends approximately 2,642,000 hours of 220,000 visitor days annually in this drainage--sightseeing, skiing, playing in the snow, camping, backpacking, mountain climbing, hunting, fishing, and gaining access to the North Cascade National Park which lies adjacent to the viewshed to the east (fig. 14, 15, and 16). Bellingham, Washington, located

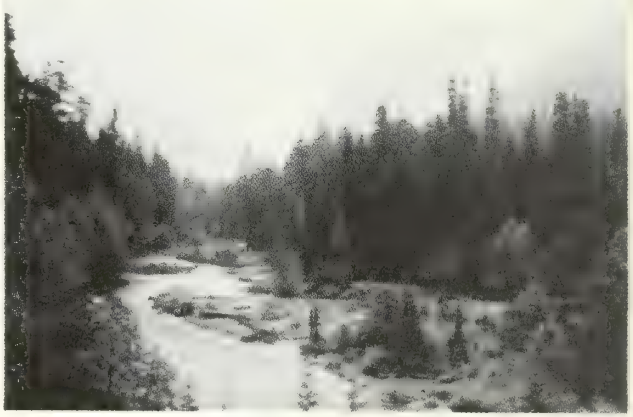


Figure 13--An example of one of the dissecting drainages.

Figure 14--Lowland camping in the North Cascade

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*See color illustration on page 395.

Figure 15--Alpine camping in the Park.

Figure 16--Winter sports activity in the Park

on Puget Sound, is 34 miles west of the National Forest boundary.

Most of the timber within the Nooksack drainage reached maturity many years ago (fig. 17). Since that time the condition of the timber has deteriorated, much of it to a state of being unattractive. Some of the older stands are being replaced naturally by a new stand of trees.

Because of the extreme sensitivity, a result of the numerous admiring visitors, very little timber has been cut. Where it has been harvested, mostly by regeneration clearcutting, the harvest is highly visible. The public has been very critical in regards to clearcutting in this viewshed.

Each National Forest District upon which commercial timber grows is required to harvest a certain volume of timber annually, based on the biological potential of the timbered portions of the District. In 1972 all National Forest lands, which at that time were not roaded, were identified and closed to any management which would result in altering the appearance of that land. Again in 1977, the unroaded land areas were reevaluated and more areas were added to be evaluated under the RARE II process.

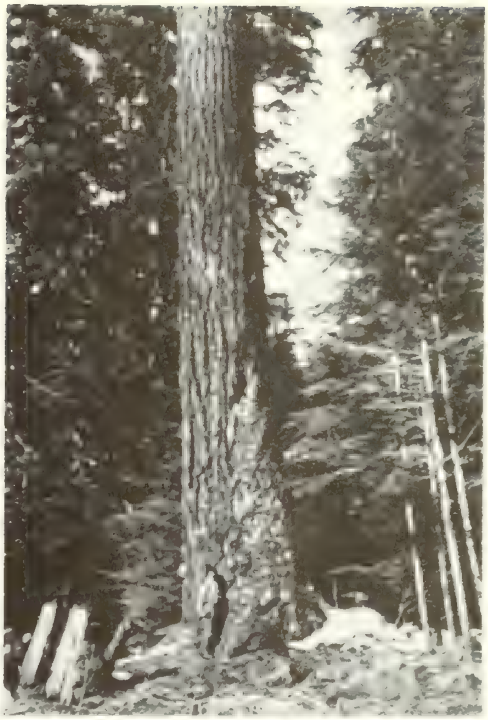

Figure 17--Old age timber within the Nooksack drainage.

The land with available timber on it became very scarce because (1) in the past most of the more gentle slopes were harvested, and (2) lands evaluated as non-roaded were excluded from timber harvest. Much of the Nooksack drainage was also involved in being closed to entry. However, in this drainage, acres of land available to timber harvest were greater than in any other drainage on the Glacier Ranger District.

The Visual Management goal is to retain the natural character of the land while managing for timber, other National Forest commodities and activities.

A viewshed study was suggested for the Nooksack drainage. The objectives of the study were to identify available timber and its ease of harvesting and retain the visual quality sought after by the public.

The Forest Service had already conducted a visual inventory which established Visual Quality Objectives. The Visual Quality Objectives were being adhered to as closely as possible by the forest managers, but were threatened by the situation at hand. It was recognized that, through the process of the Viewshed Study with the above mentioned objectives, (1) timber could be programmed for harvest and replaced with a vigorously growing stand, and (2) visual quality could be maintained.

The visual inventory indicated that any management activity, such as timber harvest or road building, must either retain or partially retain the natural landscape. It was determined that the best way to recognize those areas having ease or difficulty of achieving the Visual Quality Objectives was by identifying key physical features of the land. These features, when identified, depicted the Visual Absorption Capability of that land. Four physical features were identified and mapped (fig. 18 and 19). They were (1) soil/vegetation color contrast, (2) soil stability, (3) suitability of soil to grow vegetation, and (4) steepness of slope. (It was recognized that dominant physical features may vary with climatic and geographic location; only those physical features having greatest impact upon the study objectives should be selected; and when four or five features are used, the task at hand becomes a mind boggling monster.)

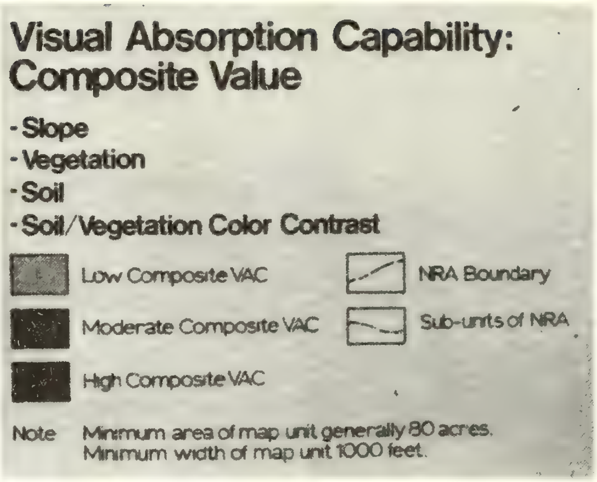
Visual Absorption Capability: Composite Value
- Slope
- Vegetation
- Soil
- Soil/Vegetation Color Contrast
Low Composite VAC
Moderate Composite VAC
High Composite VAC
NRA Boundary
Sub-units of NRA
Note Minimum area of map unit generally 80 acres. Minimum width of map unit 1000 feet.

Figure 18--Visual absorption capability: composite value key.

By combining these physical features, three ranges of intensity were identified resulting in each landscape being classified as having either high, moderate, or low VAC (fig. 19).

As the drainage is viewed from the major travel routes and use areas, certain portions are screened from view by either land forms or masses of vegetation. The screened and visible portions of the corridor were mapped and then combined with the VAC map through the use of a matrix creating and identifying six degrees of sensitivity--three seen and three not seen (figs. 20, 21 and 22).

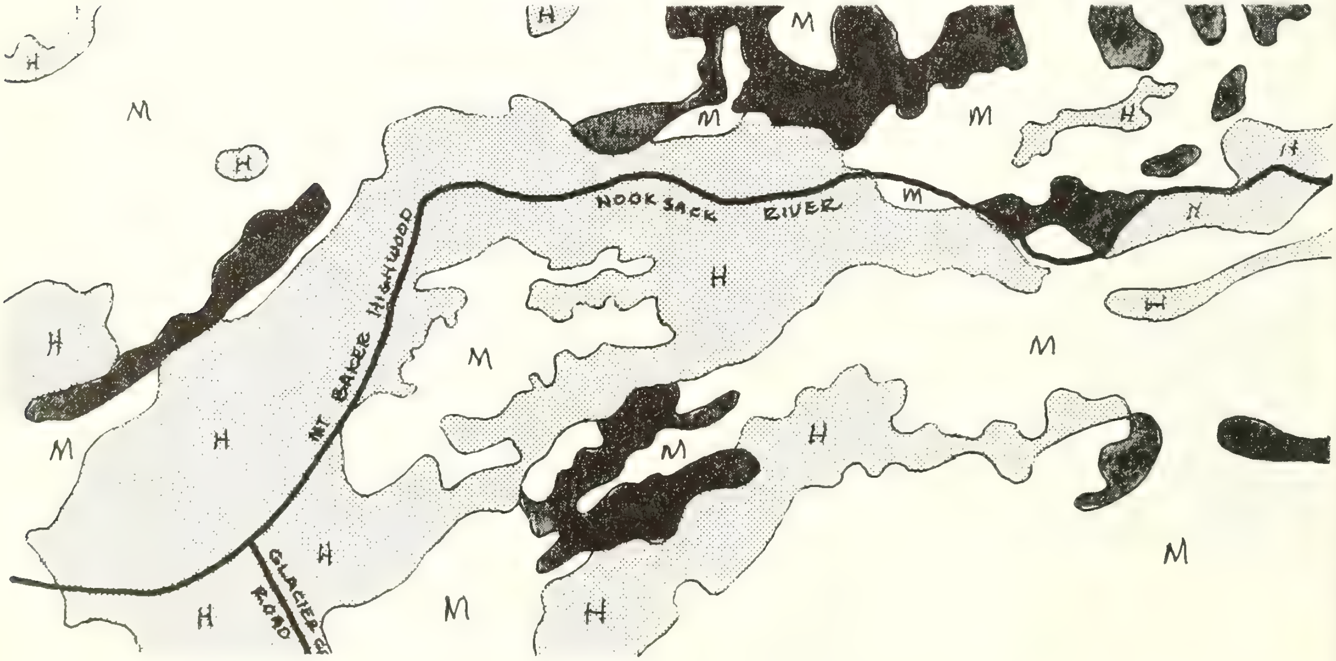

Figure 19--VAC - Visual Absorption Capability Map

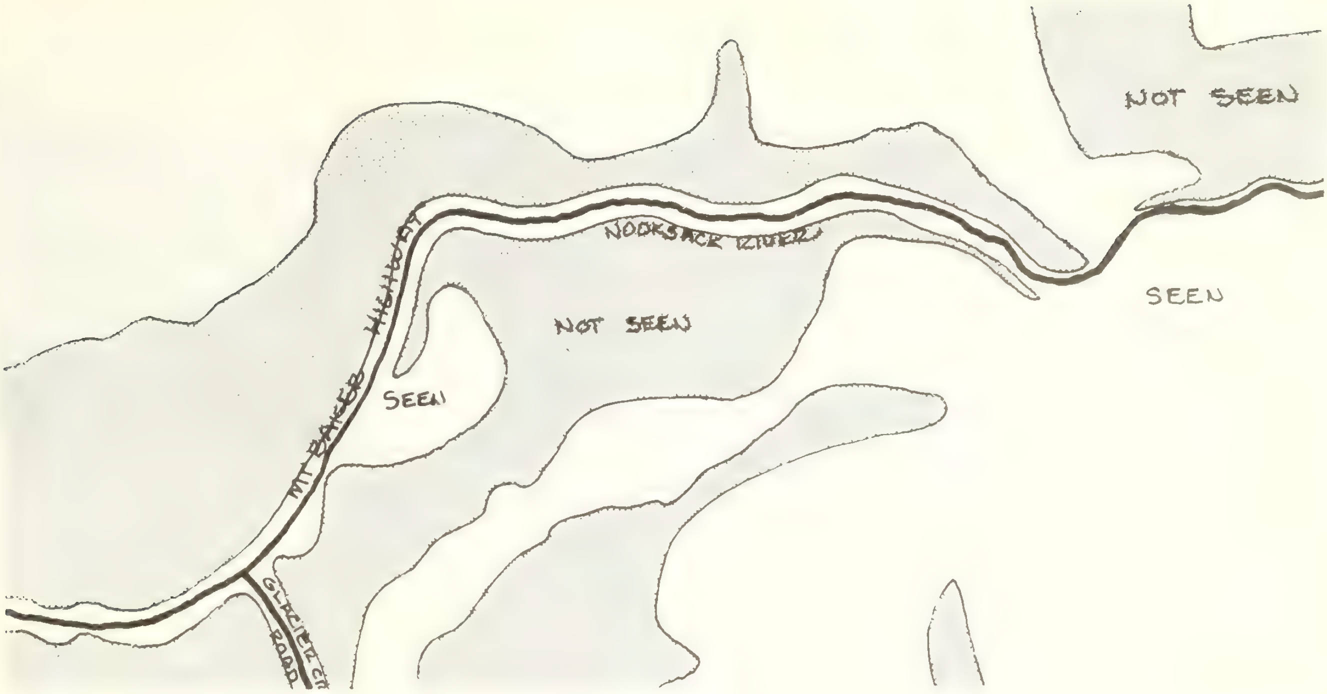

Figure 20--Seen - Not Seen Map

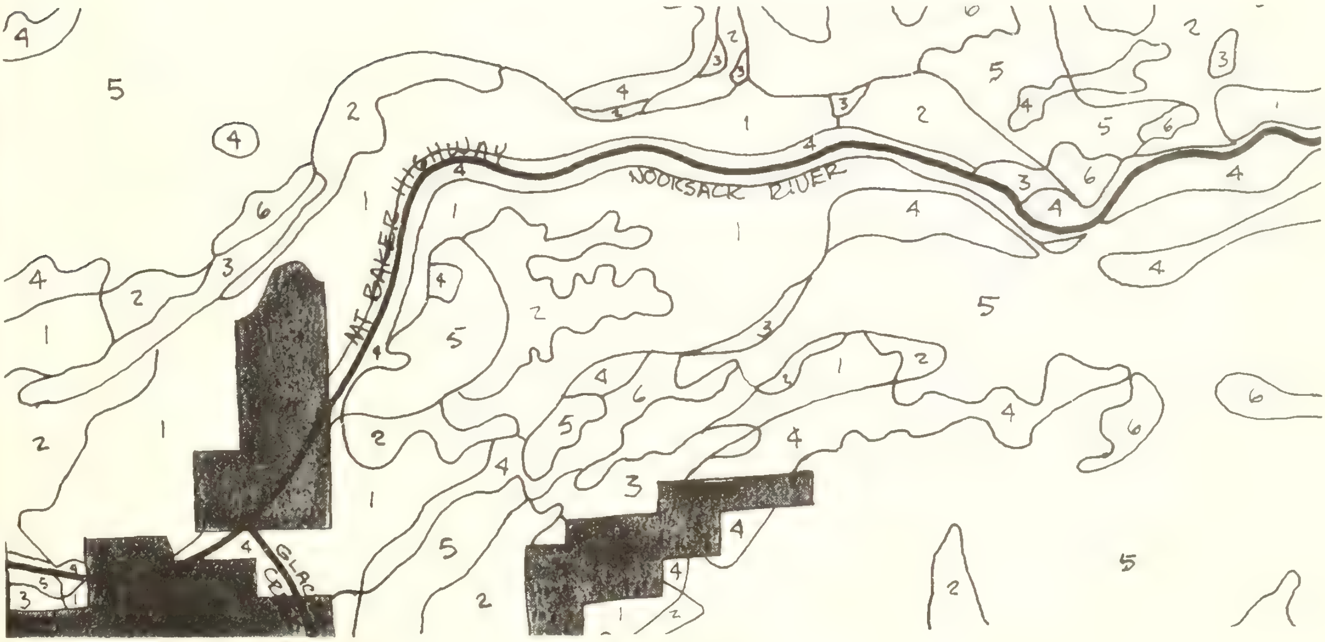

Figure 21--VAC - Seen Area Map Matrix

	VAC		
	HIGH	MOD	LOW
SEEN	4	5	6
NOT SEEN	1	2	3

Figure 22-Seen Area/VAC Matrix

The resulting map (1) recognized highly sensitive areas, both physically and visually; (2) identified areas not so sensitive; and (3) determined areas where the Visual Quality Objectives could most easily be retained.

With this accomplished we were able to begin planning for timber harvest and road location. The portions of the viewshed not seen and having a high Visual Absorption Capability lent themselves to regeneration clearcutting and road building. Those with moderate and low VAC which were not seen also lent themselves to regeneration clearcutting and road building, but with precautionary measures required to protect the land from resource damage. The portions of the drainage which were visible, and which had a high VAC, could be managed more intensely than those with moderate or low VAC.

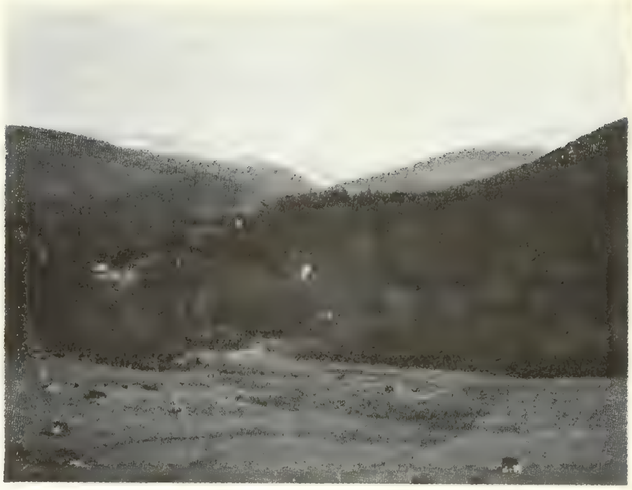

Figure 23--An example of retained visual quality.

Using this VAC and seen area data, the landscape architect, forester/silverculturist, logging system engineer and civil engineer can work as an interdisciplinary team to match visual objectives, silvicultural objectives, logging systems and the land's Visual Absorption Capability to determine location, size, method, and scheduling of timber harvest and roads to service the timber harvest activity while retaining visual quality (fig. 23).

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Project Visual Analysis for the Allegheny National Forest[1]

Gary W. Kell[2]

Abstract: The Project Visual Analysis is a landscape assessment procedure involving forest vegetative manipulation. A logical step by step analysis leads the user to a specific set of landscape management guidelines to be used as an aid in designing a project or in evaluating whether the proposed project impacts will meet visual objectives. Key elements within the procedure are: the establishment of a visual quality objective based on landscape variety, observer sensitivity, and observer distance; the identification of the visual absorption capability using 5 factors and a numerical rating system; and the evaluation of the proposed project against guidelines relating to shadow zone, size, shape and line.

INTRODUCTION

Originally developed in 1974, the methodology of the Project Visual Analysis was born out of several premises:

- Visual assessment techniques and consequent guideline formulation for vegetative impacts over recent years have been inconsistent.
- Most inventory and assessment approaches to the visual resource answer the questions of what and why, but not how.
- Few of the current approaches are easily grasped by field personnel and translated into meaningful input for implementation.
- The availability of visual resource data and the understanding of that data are lacking, yet very critical at the field level where most of the design decisions are made.
- Most proposed activities on public land require assessment of the visual resource but not all require the same depth of analysis.
- Professional expertise is not available in the field for every project.

In light of these major points a visual assessment procedure has been developed that can be applied by field personnel. The procedure is methodical, flexible and specific in application.

The Project Visual Analysis is designed for use on projects involving vegetative manipulation where the individual impact covers an area of about 100 acres or less. It will be applied on projects such as timber cuttings, right-of-way clearings, oil well clearings and borrow source clearings that are beyond the immediate foreground. Removal of vegetation was chosen as the main thrust of the analysis because it is the most frequent and significant visual impact on the forest environment. Other project impacts, such as landform alteration, addition of structures, water impoundments and recreation developments must be dealt with using other approaches.

The results of the procedure are landscape management guides determined through two key analyses. They are the Visual Quality Objective (USDA 1974), which establishes the degree of acceptable alteration of the natural landscape and the Visual Absorption Capability (USDA 1976), which indicates the capability of a specific project area to absorb certain kinds of management activities.

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[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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One of 5 brief and simple sets of guides can be chosen and used either as an evaluation of a proposed project's ability to meet the recommended visual quality objective or as an aid in designing the project. With experience, we may add other guides as well as develop inventory criteria and guides for impacts other than vegetative manipulations.

PROCEDURE

The Project Visual Analysis for the Allegheny National Forest takes the user through a logical step by step assessment, requiring the completion of up to 5 forms and 2 maps. Under the premise that the level of analysis should be commensurate with the level of visual resource sensitivity and the magnitude of the proposed impacts, the procedure was designed such that the actual number will vary with the situation. Figure 1 illustrates the steps that may be completed and their interrelationships.

In the following explanation of each step, it is assumed that a project has been proposed by the land manager and a visual assessment must be made. The term "project area" means the general area where impacts are proposed to occur. The term "impact" refers to a site specific vegetative cutting.

Step 1 - Inventory

Inventory data, based on existing ground conditions, are taken during the season in which the project area receives the most use. All existing view facilities and those proposed for the next 10 years are identified through review of maps and approved plans. A view facility can be a road, trail, recreation site, water body, residence, or other. For each view facility, views are inventoried and mapped (fig. 2). The project area will be inventoried as part of the immediate foreground, part of the distant landscape or both. The sensitivity level[3] of each view facility is identified from maps prepared for the entire Forest.

A work map (fig. 2), showing the project area, view facilities, proposed impacts and sensitivity levels should be prepared. This map will be an important working tool for the rest of the analysis and serve as backup material.

Step 2 - Sorting Questions

Next, utilizing the inventory data from Step 1, the researcher sorts and drops from the

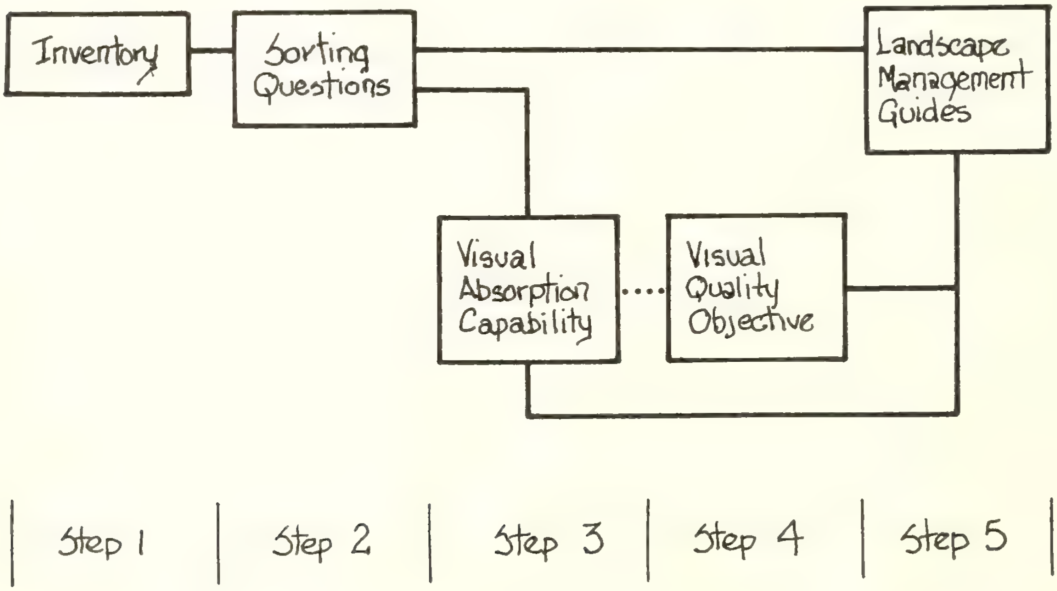

Figure 1--Project Visual Analysis Flow Diagram.

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[3] Sensitivity level is a measure of peoples concern for scenic quality. Three levels have been identified, 1, being high sensitivity, 2, average and 3, low.

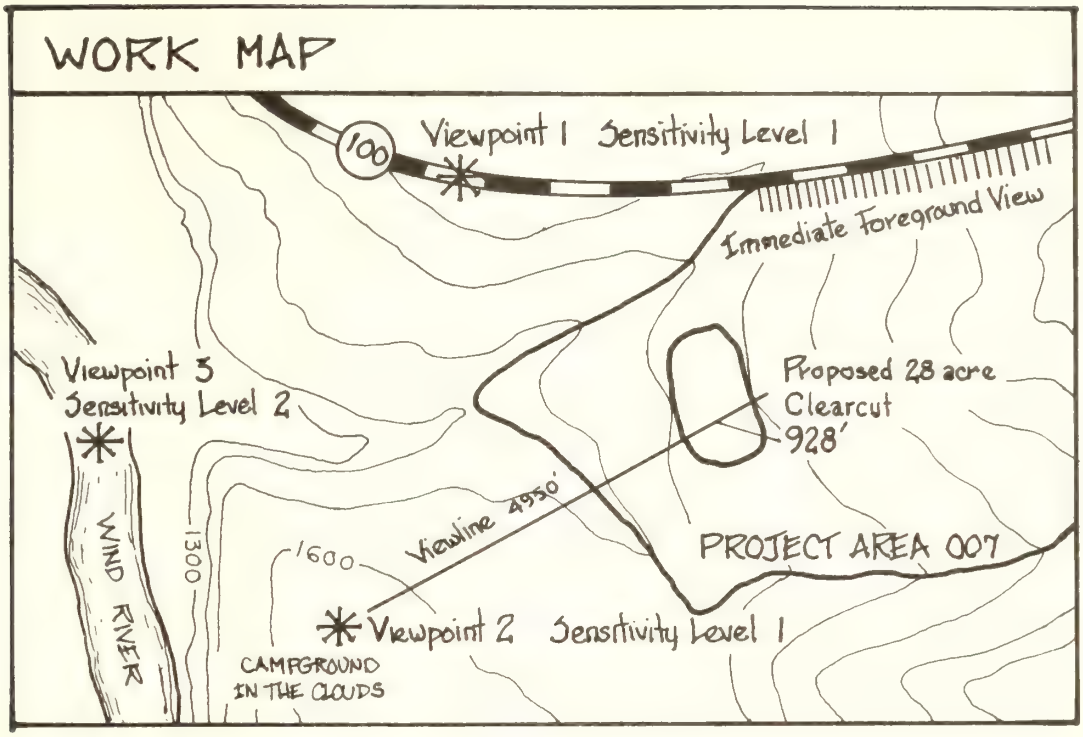

Figure 2--Example of work map and necessary data to complete the analysis for a forest clearcut.

remaining procedure any data that are not visually significant such as the least sensitive view facilities and project activities producing only minor contrasts. For these projects, analysis proceeds directly to Step 5 - and uses the least restrictive landscape management guides. Also projects that produce impacts as a part of the immediate foreground of the view facility will be referred to the landscape architect for site design recommendations. The analysis will continue on only those remaining projects that product major contrasts and will be seen from a sensitive view facility.

Step 3 - Visual Absorption Capability

The Visual Absorption Capability is an assessment of the ability of a specific land area to absorb vegetative cutting impacts. An inventory and numerical rating system based on the needs of the Allegheny National Forest has been developed to measure this ability (fig. 3). The result is an overall rating of high, intermediate or low, based on a mathematical division of all possible ratings.

First, up to 3 points that provide the best views of a specific proposed impact are identified. Then inventory data for factors relating to both the observer and the land are collected for each viewpoint. A visual absorption capability rating from a low of 1 to a high of 5 is assigned to each factor. The most critical or key viewpoint can then be determined by summarizing the numerical ratings and identifying the viewpoint with the lowest overall rating. It is this key viewpoint that will be used for further evaluation, since it has the lowest overall capability to absorb vegetative impacts. The assumption is made that if the impact is acceptable from the most critical viewpoint, then it will also be acceptable from the others.

The factors chosen for the inventory (fig. 3) are those most relevant to visual absorption capability on the Allegheny National Forest. Others such as vegetation height and recovery rate are of relevance, but because of their uniformity on the Allegheny, have no effect on the resulting visual absorption capability rating. The number of variables was limited to provide more consistent and useful results. Too many variables will produce final summaries that tend to converge upon an average value, making differentiation between high, intermediate and low difficult. They will also make the analysis unnecessarily tedious.

Step 4 - Visual Quality Objective

The visual quality objective identifies to what level or degree the land manager is willing to alter the natural landscape. Using the

VISUAL ABSORPTION CAPABILITY

				Viewpoints		
Factors		Variables	Rating	V.1	V.2	V.3
OBSERVER POSITION	Superior -	+300' - +500'	1			
		+100' - +300'	2	2	2	
	Normal	±100'	3			
		-100' - -300'	4			4
	Inferior	-300' - -500'	5			
OBSERVER DISTANCE	Foreground	0 - ¼ mi.	1			
		¼ - ½ mi.	2			
	Middle-ground	½ - 1 mi.	3	3	3	
		1 - 2 mi.	4			4
	Background	2+	5			
VIEW DURATION	Long	30+ sec.	1		1	
		10 - 30 sec.	2			
	Short	5 - 10 sec.	3			3
		3 - 5 sec.	4	4		
	Glimpse	0 - 3 sec.	5			
LANDSCAPE DESCRIPTION		Feature	1			
		Focal	2			2
		Enclosed	3	3	3	
		Panoramic	4			
		Other	5			
SLOPE	Very Steep	45+%	1			
	Steep	30 - 45%	2			
	Moderate	20 - 30%	3			
	Gentle	10 - 20%	4			
	Very Gentle	0 - 10%	5	5	5	5
Lowest rating is the Key Viewpoint				17	14	18
			Summary			

VISUAL ABSORPTION CAPABILITY

5 - 13	Low
14 - 16	Intermediate
17 - 23	High

Figure 3--Rating system devised for development of visual absorption capability.

Visual Management System developed by the USDA (1974), an objective is derived using a) the sensitivity of the viewer, b) the intrinsic variety of the land, and c) the distance from the viewer. In order to achieve uniformity, sensitivity levels and variety classes were mapped on a forestwide basis. The information, identified from these maps, combined with the distance zone from the key viewpoint yields a recommended visual quality objective (fig. 4).

VISUAL QUALITY OBJECTIVE MATRIX

		Distance Zone / Sensitivity Level						
		Fg1	Mg1	Fg2	Mg2	Bg1	Bg2	3
Variety Class	Class A	R	R	R	PR	PR	PR	RR
	Class B	R	PR	PR	M	M	M MM	MM
	Class C	PR	PR	M	M	MM	MM	MM

R - Retention M - Modification
PR - Partial Retention MM - Maximum Modification

Figure 4--Matrix for establishment of visual quality objective.

Step 5 - Landscape Management Guides

Once the visual quality objective and visual absorption capability have been identified the appropriate set of landscape management guides can be chosen (fig. 5). A total of 5 sets of guides has been conceived to cover adequately all possible combinations of visual quality objectives and visual absorption capabilities. Figure 6 shows an example of one set of guides and contains recommendations for shadow zone: size, shape and line.

Shadow zone is the area screened from view by foreground vegetation (fig.7). [4] It is a calculation of the portion of the proposed impact that it is actually viewed. In addition to inventory data from Step 3, such significant

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[4] A program has been developed for a programable pocket calculators that solves for shadow zone.

LANDSCAPE MANAGEMENT GUIDE MATRIX

I - Most Restrictive V - Least Restrictive		Visual Quality Objective			
		Retention	Partial Retention	Modification	Maximum Modification
Visual Absorption Capability	Low	I	II	III	V
	Intermediate	I	III	IV	V
	High	II	III	IV	V

Figure 5--Matrix for identification of appropriate landscape management guides.

LANDSCAPE MANAGEMENT GUIDES

LANDSCAPE MANAGEMENT GUIDES III	Does the Proposal meet this Guide
SHADOW ZONE -- Design the depth of the cutting unit not to exceed 1.5 times the Shadow Zone length.	YES NO
SIZE -- Maximum size of the cutting unit should be 24 acres.	YES NO
SHAPE -- Edges should be varied. Use undulating free-form boundaries, not straight lines or geometric shapes.	YES NO
Cutting units should be patterned on the largely horizontal form and line of the ANF landscape, that is, generally two to three times as long as wide and parallel to the countours.	
LINE -- If cutting units approach a ridgeline, design to eliminate "notch effect." Provide a transition in height from forest cover to opening by selective cutting of adjacent stands or by location and shape of cutting unit boundaries. This transition should occur in a distance equal to one-half the width of the proposed opening at a minimum.	YES NO

Figure 6--Example set of Landscape Management guides.

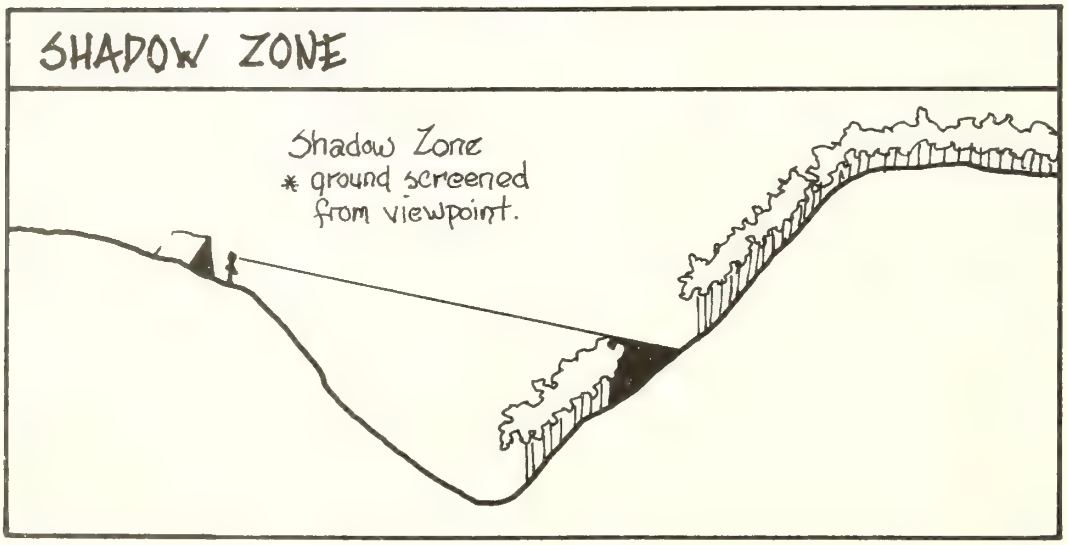

Figure 7--Shadow Zone is the amount of ground screened from view by foreground vegetation.

factors as vegetative height, view direction and aspect are incorporated into the calculation for shadow zone. The size criterion operates in conjunction with the shadow zone and sets an upper limit on the size of an impact. The shape criterion requires the form of visible openings to correspond to the horizontal line and form of the Allegheny National Forest landscape. The line criterion insures recognition of potential contrasts when a project is located against the skyline.

Depending on the number of criteria met, the proposals may proceed without change, may proceed with minor changes, or may require redesign and alternative development. In all cases, at least an office review of the inventory and analysis by the landscape architect is recommended. If fewer than four criteria are met, the user should recognize the need for some active involvement by the landscape architect beyond the analysis review. In many situations, the user may develop several alternatives by responding to the criteria within the appropriate guidelines. The criteria listed above are not meant to be a comprehensive list but a recognition of the most significant factors that affect whether the impact will meet the visual quality objective or not.

CONCLUSION

The Project Visual Analysis is a dynamic, ongoing process. The procedure is intended to be flexible enough to respond to the quickly changing needs of land managers. Revisions are constantly being made as a result of feedback from those using the process on the Allegheny. Revisions have affected the procedure and choice of inventory factors, but the basic premises and methodology remain valid. Even at this writing, areas in need of strengthening have been recognized.

It must be emphasized that this procedure is not a land use decision, but only a working tool for providing input. The procedure attempts to show how a project can be designed to meet the visual objective. The user is encouraged to retrace the analysis steps and identify the specific factors that significantly influence the results. This knowledge enables him/her to key in on appropriate design solutions. The user will have the visual data available and, once familiar with the procedure, will be able to gain understanding of how to apply them to achieve a quality visual resource.

Project Visual Analysis is a methodical, consistent approach that can be performed by adequately trained field personnel. A Visual Analysis Handbook (Kell 1978) has been developed and is being used as a training tool.

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Appropriate Combinations of Technology for Solving Landscape Management Problems—

Session K: Water Resource Development

Landscape Preference Assessment of Louisiana River Landscapes: A Methodological Study[1]

Michael S. Lee[2]

Abstract: The study pertains to the development of an assessment system for the analysis of visual preference attributed to Louisiana river landscapes. The assessment system was utilized in the evaluation of 20 Louisiana river scenes. Individuals were tested for their free choice preference for the same scenes. A statistical analysis was conducted to examine the relationship between the assessment model and the individual's preference for the scenes. The test results indicated that the logic followed in the evaluative model may be of value in the prediction of visual preference for Louisiana river landscapes.

INTRODUCTION

Objectives

The major study objectives were the following:

1. Develop and test a model for the evaluation of visual preference for Louisiana river scenes.

2. Determine if the evaluative model is correlated to individual preference for Louisiana river scenes.

Assumptions

The following assumptions were made in the study:

1. There are identifiable criteria that are important to individual perception of the environment.

2. Values can be assessed by evaluating the physical factors of river sites that are important to visual preference.

3. There is a degree of commonality in human perception of the environment.

4. Individual reactions to 35-millimeter slides are strongly related to preference for the actual river scenes.

Literature Review

Information relating to the general problem of identification of scenic values inherent in the landscape and the specific problem of the identification and evaluation of scenic attributes of water-related landscapes is quite recent. Recognizing this fact, a review of literature on the topic was done from a categorical rather than a historical perspective. The research reviewed aided in the identification of principles indicated as having a significant influence upon visual preference. The next step was to structure these principles into a logical evaluative format.

DEVELOPMENT OF THE PREFERENTIAL MODEL

A theory proposed by Stephen and Rachael Kaplan appeared to provide a basis for the structuring of a preferential model. The theory attempted to explain the perceptual process in terms of informational processing, suggesting that examination of the information an environment provides can be used to isolate components relevant to individual preference.

The Kaplans identifed two general variables aiding in the identification of factors important to visual preference. One variable concerns the order and structure apparent in a scene. The second variable relates to individual involvement or interest in a visual display. A preferred environment is, therefore, one that people can organize perceptually and also become involved with. (S. Kaplan 1975).

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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Four factors are identified as being important to visual preference in the environment, two informational variables and two involvement variables. Legibility and spatial definition are important informational variables; complexity and mystery are described as the two involvement variables.

Levin (1977) attempted to test the validity of these concepts in application to analysis of riverscape preference. It was found that the four variables - legibility, spatial definition, complexity and mystery appeared to be of value in the prediction of preference for river landscapes.

This theory seemed to provide a logical basis or structure for an evaluative model. The next step was to relate these principles to the primary landscape components - land, water and vegetation.

Two important levels of evaluation are identified. The first level of analysis involves the identification of perceptual influences. The topics of legibility, complexity, spatial definition and mystery serve as the primary factors used in this level of the analysis. The second level of the analysis involves the identification of focal elements in the landscape. These elements attract attention and can exist as positive or negative influences upon visual preference for river corridors.

The evaluative process used in this study is illustrated in table 1. Each major topic is further divided into a major variable or variables. The right hand portion of the table indicates the landscape dimension evaluated in the rating process. The 'X' indicates the dimensions rated under each of the variables. A rating may, therefore, involve the analysis of vegetation, water, land or the total scene (composite factors) according to a specific rating variable. A total of 17 factors are analyzed per landscape scene. By combining numerical values obtained in the evaluation, an "assessment ratio" is determined. This factor is hypothesised as indicating the relative visual preference value for the river scene.

A descriptive approach is used in the analysis of the 17 criteria relating each evaluation to a descriptive 5 point rating scale. Preceding each rating scale is a brief review of literature applicable to the rating topic, attempting to justify and clarify each procedure. The study is written as a "cookbook" approach, explaining rating procedures and providing descriptive rating scales with the thought that by thoroughly studying the procedures and concepts, any interested individual could apply the proposed system. The specific rating criteria and numerical scales cannot be discussed in detail in this paper, only the general framework and model applications will be addressed.[3]

Table 1 -- The Evaluative Process
for Visual Preference

LEVEL 1 PERCEPTUAL INFLUENCES

MAJOR TOPIC	MAJOR VARIABLE	DIMENSION EVALUATED			
		VEG.	LAND	WATER	TOTAL SCENE
LEGIBILITY	DEFINITION	X	X	X	
	EDGE CONTRAST	X	X	X	
COMPLEXITY	DIVERSITY	X	X	X	
	EDGE COMPLEXITY				X
SPATIAL DEFINITION	ENCLOSURE				X
	DEPTH				X
MYSTERY	MYSTERY				X

LEVEL 2 FOCAL ELEMENTS

DISTINCTIVE ELEMENTS	VISUAL DISTINCTION				X
DISTURBANCE FACTORS	HUMAN INFLUENCED SHORELINE DISTURBANCE				X
	VISUAL POLLUTION				X

PERCEPTUAL INFLUENCES

Visual perception involves the reception and processing of information obtained from a visual display (Zube et al. 1975). Historically, perception has been essential to survival. Information from the landscape provided visual clues to aid in the location of prey and protection from potential enemies. Survival depended, to a great extent, on the ability to process and interpret the information from the visual environment. (S. Kaplan 1975). The process of human visual perception involves the organization of information received from the visual array. Incoming light rays evoke perception of intensity, color and texture. Individuals attempt to organize these outlines and textural groupings into identifiable objects (Appleyard, Lynch, Meyer 1965).

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[3] A detailed discussion of all of the rating criteria, processes and weightings can be found in the authors thesis, referenced in the bibliography.

Legibility

Legibility of the visual environment is related to the perceptual establishment of relationships within and among elements of the visual display (Proshanskey, et al. 1964). Legibility is related to the ability of an individual to make sense of or to recognize relationships among parts. The viewer must be able to recognize connections and see distinction between elements.

This concept can be directly applied to the landscape components of vegetation, landform and water. Vegetation is legible when internal limb structure and connections are visible. Studies show that people demonstrated visual preference for a "parklike" situation, (Rabanowitz and Coughlin 1970) and a dislike for "unkempt" or illegible vegetation (Levin 1977, R. Kaplan 1977, 1976). Legibility or distinction of landform relates to topographic change. As slopes steepen, the viewer is able to see the slope surface and its component parts. Similarly, water gains distinction as clarity and reflectivity increase the ability to see the characteristic forms produced in water surface variation.

Contrast

Contrast is an important factor contributing to the legibility of elements in the landscape, particularly the strong contrasts produced by edge relationships. Newby (1971) states: "landscape elements are organized and identified by virtue of what designers call edges."

An edge is defined when dissimilar landscape elements merge. Sharp edges are defined as the junction between significantly contrasting (primarily height contrast) form types, typified by evoking a strong visual image. (Litton et al., 1974). Various degrees of of contrast may exist depending upon the strength or degree of height contrast exhibite by the dominant landscape elements. Litton describes this relationship between landform contrast and visual impression:

> Junctions involving general form such as a meeting between a mountain range and hill range are apt to be a subtle or inconspicuous joining rather than a positive delineation. A junction of maximum impression would be that of a mountain range against plain

Maximum landform contrast would occur where a tall cliff or bluff joined a water surface. Little contrast would exist in the combination of adjoining height classes. If water or flat land is seen in combination with low undulating landform types, lesser edge distinction would result, indicating a weaker edge relationship. A similar approach is used in the analysis of vegetation and water form contrast.

Complexity

Wohlwill describes the legibility of the outdoor environment in terms of an individual's ability to adapt to a visual experience. Each individual has an adaption level to environmental stimuli which is based upon the environment experienced in daily activity. Individuals derive pleasure in variations from this typical display; this concept is illustrated in figure 1. Any variation in the amount of stimulation will initiate a positive perceptual response. A point is reached where the response is no longer positive. The environment becomes either exceedingly complex or monotonous.

This indicates a strong relationship between legibility and complexity. A scene

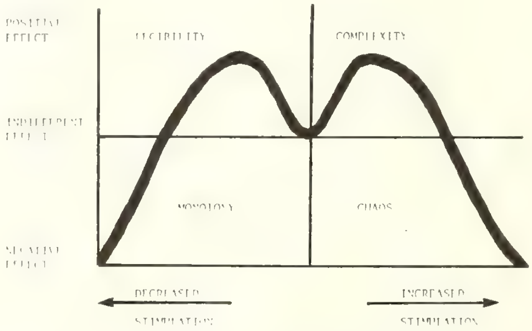

Figure 1--Discrepancy from adaption level. Adapted from Wohlwill (1966).

must be legible and individual landscape components should be identifiable, but if a visual display does not possess a degree of complexity it may become monotonous. Similarly a scene may become overly complex to the point that it is chaotic or no longer legible.

Newby defines complexity as: "relating to the intricacy of relationships which affect the rate at which information can be perceived ...complexity increases with the number of elements which can be identified." (Newby 1971). Newby identifies "elements" as being space defining components of the landscape, specifically vegetation, topography, and water. This study equates complexity with the number of legible vegetation, landform and waterform types present in a landscape scene.

Edge Complexity

Edge complexity is directly related to the irregularity of an edge; thus, visual quality is also related to this degree of irregularity. An edge may be strongly defined, yet a straight or uniform edge would provide less perceptual information than a complex or highly irregular edge. (Smardon 1972). As stated by Litton: "To the degree that an irregular shape represents a form of variety, higher quality should normally accrue to the more complex form" (Litton et al. (1974). This concept is applied to river landscapes through the analysis of the complexity or irregularity of the shoreline and skyline edges (created by the junction of landform, or structure with the atmosphere). The visual preference model utilizes a descriptive scale analyzing the complexity or irregularity of the shoreline and skyline edges.

Spatial Definition

In the environment, space is defined by physical elements. The primary space defining elements in the landscape are vegetation, land and water. Primarily, all spaces acquire their specific character from the elements that contain them. Vertical elements, more than any other elements in the landscape, develop the character of a given volume or space. The elements of landform and vegetation are the primary space definers in the natural environment. These elements are important in framing views, directing interest and creating enclosure (Simonds 1961).

Enclosure is related to visual contrast and orientation in the natural landscape. For river zones, the characteristic relationship of a water body as a flat surface indicates the potential of maximum contrast being developed as the bordering landscape elements become taller creating heightened enclosure adjacent to the water surface. Litton et al. 1974).

In this study spatial factors are analyzed in two modes. First, a descriptive numerical evaluation is conducted identifying the presence or absence of significant space defining elements (landforms, vegetation or structures). Finally, an evaluation is conducted analyzing the degree of depth (presence of a perceivable foreground, middleground or background) present in a scene. While the presence of enclosing elements appears to be strongly related to preference, (Rabanowitz and Coughlin 1970, Dearinger et al. 1973, Morisawa 1971 and Levin 1977) depth also is indicated as influencing visual preference in the landscape. (R. Kaplan 1974).

Mystery

Mystery is related to an individual's desire to enter an environment in order to obtain further information. This anticipation variable suggests to the viewer that additional information exists, and is partially hidden from view. The individual is tempted or attracted to move further into the scene.

Lynch (1960) talks about mystery related to urban landscapes:

> It must be granted that there is some value in mystification, labyrinth or surprise in the environment. Many of us enjoy the house of mirrors and there is certain charm in the crooked street of Boston. This is so, however, only under two conditions. First there must be no danger of losing basic form or orientation or never coming out. The surprise must occur in an overall framework; the confusions must be small regions in a visible whole. Furthermore, the labyrinth or mystery must in itself have some form that can be explored and in time apprehended. Complete chaos without hint of connection is never pleasurable.

Three situations are used in the evaluation of the mystery or anticipation variable. Two situations involve the placement and structure of vegetation, while one situation depends upon the relative shoreline configuration. Mystery is created by vegetation directly or indirectly.

Vegetation can partially obscure a view to the surrounding river environment. Vegetation may also indirectly create a sense of anticipation, by limiting and modifying the amount of light entering a visual display. Alteration of light intensity by vegetation can obscure vision by producing darkness or by modifying light patterns.

Shoreline configuration is also directly related to the mystery dimension. In this situation, mystery results from the inability to see what lies beyond. A broad, sweeping curve totally obscures what lies ahead. This configuration creates anticipation and induces individual movement further into a space. (S. Kaplan 1974, Levin 1977). This concept is applicable to the basic river structure, or the configuration of any circulation corridor where movement provides the participant with a sequential viewing experience.

FOCAL ELEMENTS

The second level of evaluation is difficult to explain in terms of the visual preference model. These factors are identified as elements that attract attention in the landscape, often producing a significant influence upon individual preference. The effect of focal elements on preference is related to the perceptual influences of legibility, complexity, spatial influence and mystery. These factors obviously affect the distinction of a focal element, but there is another influencing factor, purely personal, highly emotional and regional in nature but of importance to individual preference in the landscape.

Distinctive Elements

Distinctive elements in a visual array may be simply defined as: "elements in the visual display that are differentiated from associated landscape elements " (Litton et al 1964). Litton divides elements in the distinctive category into two groups: feature elements and point elements.

Feature elements are distinguished from point elements primarily due to rarity in the landscape. A feature element in the Louisiana landscape may be included in any of the three general categories:

(1) Distinctive landform features: such features may include visually dominant bluffs, cliffs or escarpments.

(2) Distinctive vegetative features: such features may include vegetation distinguished by (a) age distinction and (b) rarity of species type.

(3) Distinctive water features: Such features may include waterfalls or turbulent rapids.

Point elements occur commonly in the river environment. Typical examples of point elements would include distinctive vegetation, specimen trees, logs or snags, rocks or rock outcroppings, and sand bars. Despite the fact that point elements often lack the emotional impact indicated by the presence of feature elements, point elements may serve as important elements to attract the eye and provide striking contrast or focal reference. The visual distinction of a feature or point element is evaluated according to the rarity, contrast and relative placement of the element in a visual display.

Disturbance Factors

Feature elements possess the ability to evoke a positive emotional response related to visual quality in the river environment. Similarly, factors exist which can produce highly emotional negative impacts upon viewers. These elements are identified and analyzed as disturbance factors. Disturbance of the natural environment occurs when human influence initiates destruction or alteration of the natural interface between water and land (shoreline).

The shoreline is extremely fragile and is subject to destruction by direct human influence. Alteration of this native shoreline character may produce a negative influence upon the visual quality of the natural river environment. An analysis is conducted and a numerical rating is assigned through an analysis of visual contrasts produced by human activities on the shoreline environment.[4]

ADJUSTING THE VISUAL ASSESSMENT RATING

The evaluation for each scene is recorded on a sheet similar to that presented in table 2. Each of the 17 specific rating factors is analyzed and given a numerical rating from 1 to 5 based upon the detailed rating criteria presented in the original study. The rating dimensions evaluated in each scene are only those that can be thoroughly analyzed according to the information presented in the evaluative model. If a dimension is not clearly visible, it can obviously not be thoroughly evaluated. Once the analysis is complete the numerical ratings are added and totaled. This total is divided by the total possible points producing a ratio that indicates a relative preference value for each scene.

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[4] Refer to the Bureau of Land Management, USDI, Visual Contrast Rating System, Manual B431

Table 2 -- Sample Evaluative Rating Sheet

DATE ____________ SLIDE # ____________

RIVER ____________ EVALUATOR ____________

VARIABLE	DIMENSION	RATING DIMENSION	RATING SCALE					RATING
			1	2	3	4	5	
LEGIBILITY	DEFINITION	VEGETATION						
		WATER				X		4
		LANDFORM	X					1
	CONTRAST	VEGETATION					X	5
		WATER		X				2
		LANDFORM	X					1
COMPLEXITY	DIVERSITY	VEGETATION		X				2
		WATER		X				2
		LANDFORM		X				2
	EDGE COMPLEXITY	SKYLINE			X			3
		SHORELINE			X			3
SPATIAL DEFINITION		ENCLOSURE			X			3
		DEPTH					X	5
MYSTERY		MYSTERY		X				2
DISTINCTIVE ELEMENTS		DISTINCTION		X				2
DISTURBANCE FACTORS	SHORELINE DISTURBANCE	HUMAN (INF.)					X	5
		POLLUTION					X	5

* (1) Total Points 50

* (2) Total Possible Points 85

ASSESSMENT RATIO .588

* Total possible = number of factors rated X 5

* Assessment ratio - (1) divided by (2)

TESTING THE PREFERENTIAL MODEL

The evaluative system was used in the analysis of 20 Louisiana river scenes. A form similar to that presented in Table 2 was utilized in the evaluation of the scenes. A ratio indicating the relative preference value of each scene was determined.

One hundred landscape architecture students evaluated each of the 20 scenes. The students indicated their free choice preference evaluating each scene on a 1 - 7 rating scale which was based upon the relative beauty or unattractiveness of the scene.

The results of the evaluations were totaled and a hierarchy (1-20) based upon visual preference was produced for the model-based evaluation and the respondent evaluation. The rankings for the two evaluation procedures were then compared statistically to determine if a significant correlation existed between the two procedures. The Kendall rank correlation coefficient was utilized in the analysis results (Siegel 1956). The statistical analysis indicated a strong relationship existed between the model ranking and the respondent analysis of the 20 river scenes. An analysis of the scenes was then conducted speculating on factors contributing to preference for the Louisiana river landscape.

DISCUSSION OF THE RESULTS

All of the high scoring river scenes rated strongly in terms of legibility of vegetation. Legible vegetation allows for visual examination of individual plant forms and limb structure, resulting in more clearly defined perceptual information being conveyed to the viewer, thus producing a positive preferential response. Tangled vegetation limits the ability to process the visual stimuli and results in confusion for an observer.

The lack of topographic change in Louisiana decreases the significance of landform and increases the impact of vegetation upon visual preference. The visual preference for the Louisiana river landscape appears to be highly dependent upon the legibility, contrast, and complexity of vegetation. In regions of low relief, vegetation becomes the primary formative element in visual display. In regions of significant topographic change, the landform legibility, contrast and complexity dimensions would gain importance relating to individual preference for the river environment, while the importance of vegetation would be diminished.

It appears that all of the variables used in the study are interdependent. Analysis of complexity involves the identification of form variations of land, water or vegetation, which are highly dependent upon the legibility of a scene. Separate form types would be difficult to distinguish if the scene were not legible. Mystery also appears to be strongly related to spatial definition and configuration.

The study indicates that recreation preference or "intended use" has a significant impact upon visual perception. For example, a canoeist may place high visual preference on factors which would affect use or recreational desires. This concept could apply to the

the legibility of vegetation or the legibility of water dimensions. Illegible vegetation does not allow for visual penetration or physical penetration into the shoreline environment, while illegible water (muddy turbid water) would discourage swimming and other related water activities. This discussion indicates that specific rating criteria will influence individual perceptions differently. This influence appears to be related to recreation desires, regional and social factors. The influence of these factors on the model criteria should be analyzed in greater detail.

CONCLUSIONS

The analysis indicates that the logic used in the establishment of the preferential model may be of value in the prediction of preference for Louisiana river landscapes. The basis for the evaluation is derived from previous attempts to explain human preference in terms of informational processing theory. This approach appears to be of value in the explanation of human preference for river landscapes.

In this study the general concepts proposed in the informational theory were expanded, applying them to the landscape components of land, vegetation and water, attempting to creat a model that could predict human preference for Louisiana river landscapes. In this analysis the importance of the interdependence between the evaluative factors becomes readily apparent. The strong interdependence among factors indicates that a scene will not possess exceptional preferential value with one or two of the characteristics (legibility, complexity, spatial definition, mystery, distinction or disturbance) dominating, while placing the other factors in a subordinate position. A very high ranking scene in terms of visual preference, in most instances, will possess qualities relating to each of the factors. Thus, the mixing and combination of the factors and the resultant effect upon visual preference appear to be more significant than the effect of a single factor. To what extent each of the factors influence perception could not be concluded in this study. This concept indicates potential areas for future research.

UTILIZATION OF THE STUDY

The study is founded upon the assumption that a visual experience on a river consists of a series of views or sequential glimpses down a river corridor. If a system were developed to evaluate the visual preference for these views, a significant tool will be available for the evaluation and subsequent land use planning in river corridors or any water related landscape. The model could be used as the basis for the establishment of an inventory system for the analysis of rivers in Louisiana. Coupled with a photographic inventory, the model could be used to evaluate river systems eventually resulting in the establishment of a hierarchy of rivers or river sections based upon predicted preferentia value.

A numerical value described in the study as an "assessment ratio" is determined following the format discussed in this paper, for each of the photographs or slides. A photographic inventory could be conducted on all rivers or river sections indicated for designation in a scenic river system. By evaluating each photograph numerically according to the 17 rating criteria and totaling these values, a hierarchy could be established based solely upon visual preference. Rivers or river stretches rating the highest might be preserved while other use designations would be given according to the numerical results of the evaluation.

At a site scale of evaluation, the model could be used to identify key river stretches and distinctive river sections. Zones could be located relating to a hierarchy of uses based upon visual preference. For example, a recreational activity might be located in a zone of low visual quality, while viewing or observation points may be established in key visual zones which have been set aside for protection. The detail of the photographic inventory indicates the detail of the analysis.

The model could also be used to locate key areas for recreation sites, bridges or powerline crossings. An evaluation could be made on the impacts of proposed or existing activities on visual quality. A more detailed analysis of the inventory data would yield information on individual rating factors such as complexity, spatial enclosure, legibility, shoreline disturbance, etc.

FUTURE RESEARCH

It is important to stress the need for extensive testing of the concepts discussed in this study. Testing should take place further analyzing each of the rating dimensions utilized in the model evaluation. Each of these dimensions should be tested examining the influence of the dimension upon visual perception. Once the significance of each of the rating dimensions has been evaluated, the relationships among these dimensions should also be examined. Statistical tests should be run on the relative significance and behavior of all of the dimensions, as well as the relationships between dimensions. Limitations in the scope of this study did not allow for extensive statistical analysis of the evaluative model. The preliminary indications are that the model has value in the assessment of visual preference for Louisiana river landscapes, but the use of the system for practical purposes should not be conducted until the model has been adequately tested and revised for utility, clarity and accuracy.

Additional analysis should be conducted testing the concepts proposed to determine the correlation between landscape preference and visual quality evaluation in the landscape. Such an analysis is needed in the development of visual assessment systems. Such systems would be of significant value in the land use decision making process.

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Management of the Lower St. Croix Riverway: The Application of Cognitive Visual Mapping and Social and Resource Assessment Methods[1]

Robert Becker[2]

William Gates

Bernard J. Niemann, Jr.

Abstract: This paper provides an overview of methods and results obtained from an extensive social and recreational carrying capacity study conducted for a National Scenic and Recreational Riverway - the Lower St. Croix. The paper also includes preliminary results and illustrations of a cognitive mapping technique for mapping scenic beauty. Over 1000 separate polygons were utilized in the analysis obtained from on-site and riparian users. In addition, user displacement from recognized beautiful areas (St. Croix) to areas of fewer users (Mississippi) is discussed.

INTRODUCTION

Increasing recreational use of outdoor public areas and resources has created widespread concern over the effects of use on irreplaceable natural resources and user satisfaction, and on the adequacy of management plans for these areas. Ever since (or possibly because) the Lower St. Croix became part of the National Wild and Scenic Rivers System in 1972 (Public Law 92-560), the area managers and the public have perceived a set of problems. They range from use conflicts, continued efforts to expand marina and launch ramp facilities and degradation of the resource. As a result in 1977, the Minnesota Environmental Quality Board required that:

> A definitive research study be undertaken cooperatively between the Secretary of the Interior and the two states (Minnesota and Wisconsin) to determine the optimal carrying capacity of the

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[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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Lower St. Croix Riverway...to identify resource constraints, facility capacities, and sociological or socio-esthetic values. Any future access expansion, site development and water or land zoning would benefit from guidelines determined in this matter.

Why is this study important? Why the interest in the Lower St. Croix? Why was the Lower St. Croix included as a National Recreational and Scenic Riverway? Why was the entire St. Croix system considered to be so significant and unique that it was worthy of being a major component in the National Riverway System and the only component included from its headwaters to its confluence? The reasons have something to do with the uniqueness of the riverway, the recreational opportunity, the quality of the resource, and the proximity to a large metropolitan user population. Also in comparison with over riverways in the U.S., the St. Croix represents one of the last remaining recreationally unimpaired riverway system in the Upper Mississippi Basin (Upper Mississippi River Basin Commission 1970).

While considerable information is known about the characteristics and distribution of the biological, physical and physiographic characteristics of our natural areas and a growing base of information is at hand regarding user characteristics, little has been done to merge these components. Social and resource data have existed in separate realms. This separation is incongruent with the theme of optimal resource utilization. To overcome this separation, this river recreation carrying capacity project consciously sought to interface both the social and resource data sets (Becker, Gates and Niemann 1978).

To accomplish the directive of the Minnesota Environmental Quality Board; responding to the need for merging the physical characteristics of the riverway with its use patterns, and the requirement of understanding the regional uniqueness of the setting and experience, an integration of methods was employed. The array of methods employed, the results and the subsequent management action are the focus of this paper.

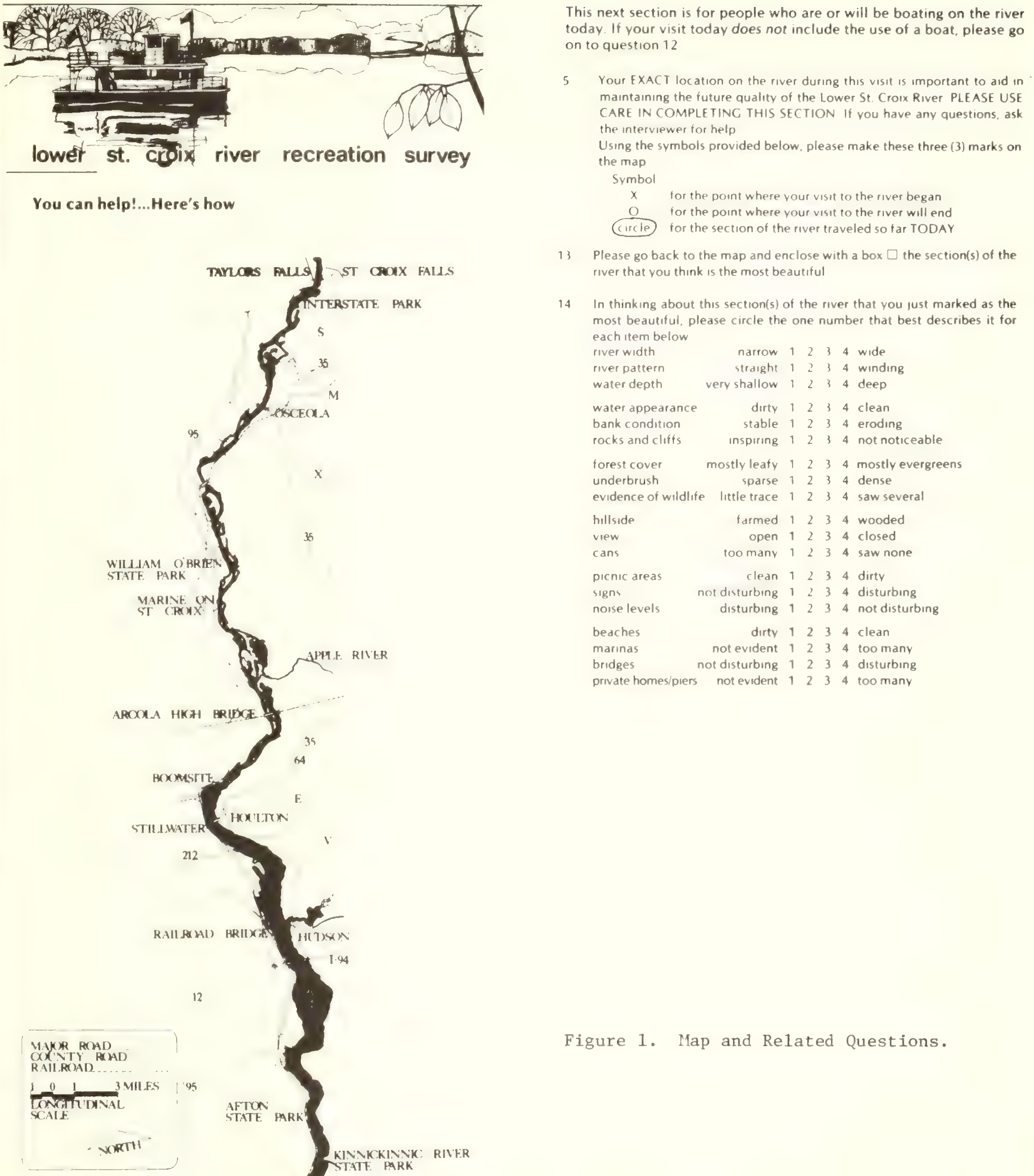
In summary, the study goal was to understand:

(1) the effects of riverway users upon other riverway users;
(2) the effects of riverway users upon the resource; and
(3) the effects of the resource upon riverway users.

METHODS

To accomplish the study goal, the research team employed an integrated set of social and resource measurement and analysis techniques. These included questionnaire measures from on-site users, riparian landowners, the St. Croix Riverway managers, and river users on the nearb Mississippi. The on-site and riparian landowne questionnaires and some questions were located and coded geographically. They provided user generated geographic perceptions, e.g., scenic beauty, areas travelled, areas avoided, etc., by a cognitive mapping procedure included in the self-administered questionnaire. Over 2,00 questionnaires were obtained and analyzed requiring extensive data base management with innovative display and analysis procedures. For example, because geographic coordinates were maintained on every questionnaire, it was possible to use computer graphics to depict areas along the river travelled by various types of boats, and areas considered most beautiful. The study was also one of the first to test the concept and obtain results that recreation-use is a social/spatial phenomenon. For example, both on-site users and riparian landowners mapped specific information in the form of polygons on a map provided as part of their questionnaire. Figure 1 shows the actual map, directions and symbols employed. The original scale in the questionnaire was 1"=5.77 miles. While cognitive mapping techniques have received historic criticism regarding inability of individuals to read or comprehend maps, users on the Lower St. Croix exhibited a remarkable ability to record spatial properties. Over 78 percent of on-site users and over 81 precent of landowners identified riverway locations they considered beautiful as well as the physical/social characteristics they associate with these areas (see figure 1). This resulted in over 1,000 individual polygons which require combinative anslysis. Also, because geographic information was maintained, the concept of use displacement in both time and space was tested and substantiated.

To determine water craft distribution, type of use, and density of use slightly oblique black and white aerial photography was employed. The method included the use of two canted 35 mm Nikon motor drive cameras (see figure 2). An example of the results can be observed in Figure 3. This is 15x magnification of the 35 mm photography using a Bausch and Lomb 200 mm stereoscope. At this magnification boats can be classified according to type. Four cabin cruisers and one house boat are shown.



This next section is for people who are or will be boating on the river today. If your visit today *does not* include the use of a boat, please go on to question 12

5 Your EXACT location on the river during this visit is important to aid in maintaining the future quality of the Lower St. Croix River PLEASE USE CARE IN COMPLETING THIS SECTION If you have any questions, ask the interviewer for help

Using the symbols provided below, please make these three (3) marks on the map

Symbol	
X	for the point where your visit to the river began
O	for the point where your visit to the river will end
(circle)	for the section of the river traveled so far TODAY

13 Please go back to the map and enclose with a box ☐ the section(s) of the river that you think is the most beautiful

14 In thinking about this section(s) of the river that you just marked as the most beautiful, please circle the one number that best describes it for each item below

river width	narrow	1	2	3	4	wide
river pattern	straight	1	2	3	4	winding
water depth	very shallow	1	2	3	4	deep
water appearance	dirty	1	2	3	4	clean
bank condition	stable	1	2	3	4	eroding
rocks and cliffs	inspiring	1	2	3	4	not noticeable
forest cover	mostly leafy	1	2	3	4	mostly evergreens
underbrush	sparse	1	2	3	4	dense
evidence of wildlife	little trace	1	2	3	4	saw several
hillside	farmed	1	2	3	4	wooded
view	open	1	2	3	4	closed
cans	too many	1	2	3	4	saw none
picnic areas	clean	1	2	3	4	dirty
signs	not disturbing	1	2	3	4	disturbing
noise levels	disturbing	1	2	3	4	not disturbing
beaches	dirty	1	2	3	4	clean
marinas	not evident	1	2	3	4	too many
bridges	not disturbing	1	2	3	4	disturbing
private homes/piers	not evident	1	2	3	4	too many

Figure 1. Map and Related Questions.

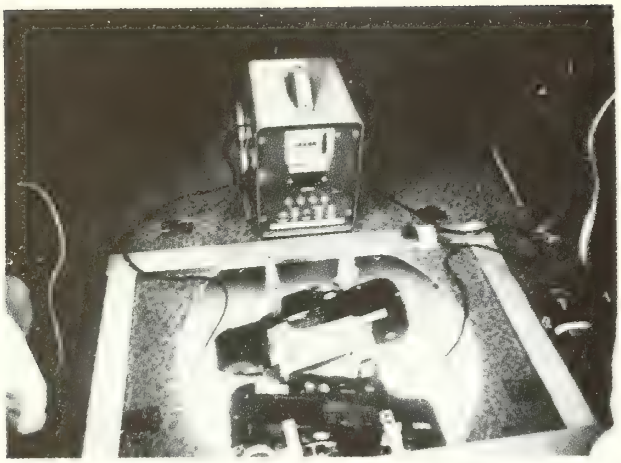


Figure 2. 35 mm Nikon Motor Drive System.

Figure 3. Enlarged 35 mm Photography.

The resource conditions were obtained from a set of 52 randomly located transects along which plant communities, plant species, soil texture, relief, orientation and recreational disturbances were collected and analyzed. In addition, disturbance measures were obtained from 10 percent of the recreation sites, comparative plant community measures were obtained to determine how much recreation activity was changing these community structures, and litter measures were also conducted.

Another source of resource information was obtained from two 1:24000 (spring and fall) color infrared flights of the riverway. Various resource measures were interpreted from this photography and placed into a 3-acre interactive geobase (GRASP) (McCown, Butler and Gates 1975).

Data Collection Methods

Instrument and Method Summation

On-Site Questionnaires--A pilot on-site survey was conducted between May 23 and June 19, 1977 and 1704 final questionnaires were used between June 20 and September 5, 1977. Two compatible questionnaires were distributed equally over selected times and locations over the entire 52 miles of the Lower St. Croix Riverway.

Landowner Questionnaires--All adjacent riverway and private owners were identified from both the Minnesota and Wisconsin portions. In July, approximately 900 valid residents were established and eventually 420 were returned for analysis.

Regional Questionnaires--In December 1977, 900 Lower St. Croix and Upper Mississippi on-site users were sent a regional questionnaire. A total of 502 regional questionnaires were returned for analysis.

Manager's Questionnaires--Questionnaires were mailed to 30 riverway managers, 28 were returned for analysis.

35 mm Aerial Photography--Thirty-eight 35 mm water craft user flights were obtained between May 23 and September 5. Twenty-two flights were determined acceptable for analysis. Fifteen flights were utilized to determine overall water craft use and distribution.

Resource Data Collection Methods

Transect Measurement--As described earlier, 52 transects were located from which on-site questionnaires were obtained and along transects upon which the resource was inventoried. Various types of resource information were recorded including plant communities, plant species, soil texture, relief, orientation and recreational disturbances.

Disturbance Measures--This technique involved quantitatively comparing the percent and type of disturbance for approximately 31 (10%) recreational sites (e.g., marina, beach, island, etc.). Indices such as "weed" species plus non-vegetative features such as litter, asphalt, etc., were utilized as indicators of disturbance.

Community Measures--This technique was utilized to measure, quantitatively the degree to which sites in heavily used recreation areas have vegetatively changed due to use. Three pairs of sites were sampled plus one dredge spoil island.

Visual Water, Litter and Noise Quality Measures--These quality conditions were made at each site where questionnaires were obtained; 125 samples were obtained from 105 sites.

Additional Sources--Additional information about the resource (e.g., water level changes) was obtained from two 1:24000 color infrared flights. In addition, information about the resource, particularly wildlife, was obtained from interviews with local experts.

RESULTS

Use Patterns

In 1970, the Minnesota-Wisconsin Boundary Area Commission estimated that approximately 205,000 persons visited the area via watercraft. During 1977 a use estimate of 832,649 (± 8.4 percent error) was generated representing an increase in excess of 406 percent in just seven years. In 1970, a high use boat estimate of 800 was reported. In 1977, utilizing an aerial camera technique a high use daily estimate of approximately 3384 was derived, with a total boat estimate of 219,118 from Memorial Day through Labor Day. This represents an increase of 423 percent or 22 percent per annum growth in seven years.

Use of 35 mm aerial photographic analysis provided more than simply a means of counting boats. The results from the technique indicated that lower river surface use was affected by launch ramps (approximately 64 percent) more than slippage (36 percent). The technique provided a basis for monitoring watercraft distribution. Time photoanalysis results reveal approximately 60 percent of all crafts on the riverway are stopped at any given time. This compares with user questionnaire results of over 64 percent of users reporting stops.

As previously discussed a primary study objective was the integration of social and natural phenomena via their spatial and temporal locations. To accomplish this social data collection methods were constructed to associate user responses with a geographical area or place. The on-site questionnaire asked users to make some of their responses on a map included in the questionnaire. This afforded a mapping of: attitudes, behavior patterns and aggregate preferences over the geographical surface of the riverway. For example, areas of the river most heavily travelled are graphically depicted in Figure 4.

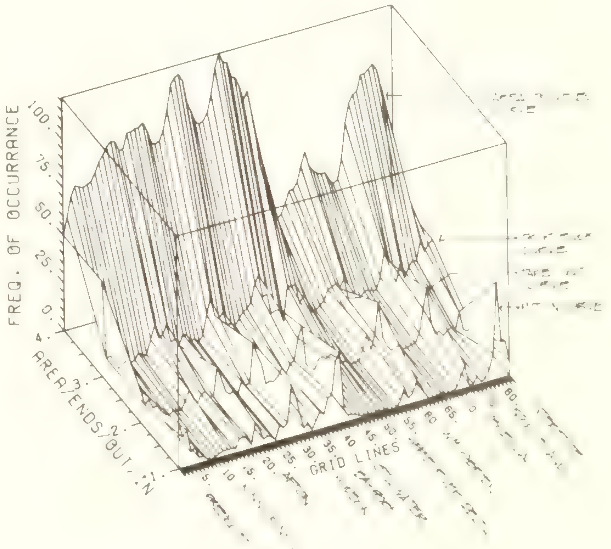


Figure 4. Areas Travelled.

Use is significantly higher on the lower reach of the Lower St. Croix (a deep water area). Examination of the computer generated plot reveals heaviest travel in the Stillwater area, through the Hudson Narrows, and the Kinnickinnic Delta on the lower river and Interstate Park to Osceola on the upper reach. Figure 4 further reveals, for example, numbers of beginning trips at Taylors Falls and taking out at Osceola and William O'Brien, an area dominated by day-use canoeists. The influence to the Lower St. Croix from the Mississippi is also evident in presence of a high trip "end" point at Prescott. The "end" category refers to northern and southern points of area traveled.

Resource Conditions

As previously mentioned in the introduction, to understand the interaction between the recreational use and the physical characteristics of the riverway, a series of resource data collection methods were employed. Resource quality measured received considerable attention because of their importance, but also because resource quality is very important to users of the Lower St. Croix who are seeking an unimpaired recreational experience.

In general, the investigators found that the Lower St. Croix Riverway is composed of striking as well as subtle natural features. For example, the striking features near Taylors Falls include sheet basalt rock surfaces and unusual rock potholes. In other riverway locations, Pre-Cambrian sedimentary rock bluffs and cliffs are exposed. In some areas which are unaccessible to the white tailed deer, the once pervasive but now rare Canada yew (Taxus canadensis) can be observed.

The Apple River Delta, in contrast, consists of an interlaced network of wetland and shallow water channels where patches of wild rice (Zizania acquatica) exist. These wild rice patches attract various and interesting types of migratory waterfowl. In some isolated upland areas, the rare and endangered and highly sought after Ginseng (Panax quinquefolium) can be observed. In the lower riverway near the Kinnickinnic River Delta isolated prairie environments are observable.

More specifically, the application of methods for determining interaction between the recreational and riparian user and the resource, the transect results are of interest. The transects were used as a basis to monitor the condition of 17 representative plant communities. An array of pre-selected vegetational disturbance indicators were utilized.

The highest recorded disturbance along the river is the presence of trails which occurred in 16.9 percent of the sample communities. Highest occurrence of trails is in the Lowland Forest (24.3 percent) which according to its distribution, accounts for almost the entire shoreline and island vegetation. Litter was recorded in 13.3 percent of the stands and has its highest frequency value in the lowland forest where 41.8 percent of the litter was found. Another 12.7 percent was found in the sandbar-mudflat-shoreline communities. These two community types account for most of the useable island and shoreline space. Litter was found in 15 of 17 community types. Hacked wood has been recorded in 9.6 percent of the stands. Of the occurrences of this disturbance type, 35 percent were recorded in the lowland forest community, 10 percent were in the wet-mesic forest, which is often adjacent to the lowland forest, and 10 percent in the cliff communities adjacent to lowland and wet-mesic forests. This indicates that users are depleting the supply of natural firewood on the islands (the lowland forest communities) and are beginning to cut standing timber. Trampling was found in 8.7 percent of the samples and is important because of its relatively high occurrence in island and shoreline community types, including 25 percent in lowland forests, 16.7 percent in sedge meadows and 11.1 percent in sandbar-mud-flat-shoreline communities. Several of the dry prairie remnants have been noted for possible preservation by the Scientific Area Preservation Council of the Wisconsin Department of Natural Resources.

Perception of the Resource

Beauty and unique environmental areas are the elements of the Lower St. Croix Riverway most often cited as special by users. It is interesting to note portions of the Riverway various users called beautiful (figure 5). There is a strong relationship between the portions of the river the on-site visitor uses and the area identified as beautiful: Interstate, Rock Island; Apple River Delta; and Kinnickinic Delta.

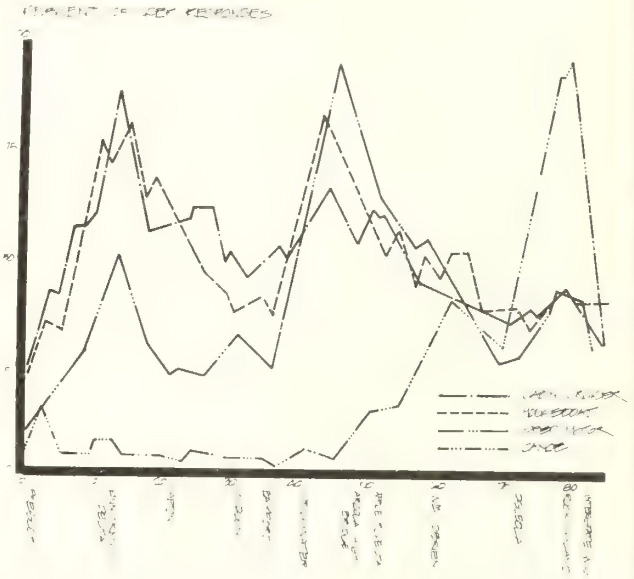


Figure 5. Beauty Along the Riverway as Perceived by Users in Various Boat Types.

Figures 6*and 7*illustrate the character and type and density of the use of the Kinnickinnic River Delta. Figure 6*is a high oblique photograph of the Kinnickinnic River Delta State Park. This is a unique recreational resource within the lower reaches of the Lower St. Croix River because of its expanse of beach space. Figure 7*is a low oblique photograph taken of the lower right portion of the Kinnickinnic Delta from the opposite direction as figure 6*. It illustrates the importance and competition for available beach space among users of the lower portion of the St. Croix. Within each of the three areas, the resource characteristics which affect the perceptions of beauty were sampled (see figure 1). This analysis is presently in progress.

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*See color illustration on page 396.

Preliminary analysis indicates that those resource qualities associated to areas with high visual quality are characterized and perceived in a common way across on-site user groups. It also appears that generally the absence of man-made intrusions such as litter and development are common attributes of the areas considered most beautiful.

In contrast to on-site user beauty responses, which was associated with areas travelled, riparian landowners' identification of beauty was not associated in proximity to their residence. Figure 8 exhibits the landowner pattern of perceived beauty compared with the on-site users' perception of beauty.

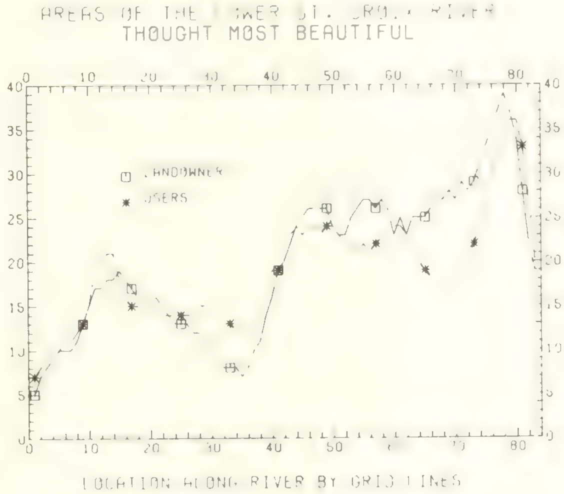

Figure 8. Most Beautiful Areas on the Lower St. Croix River.

This plot represents the aggregation of 810 on-site user-generated polygons and 261 riparian landowner polygons. Distance from the X axis to the curve represents the proportion of each response group identifying specific grid points along the riverway which were included in "their" beauty polygon. As would be expected variance existed regarding the geographic specificity of respondents, i.e., the size of their polygon. The small scale of the map probably contributed to polygon variance as would probable data extraction error.

Data were removed from the map via an eighty-three point grid overlay. "End" values (horizontal grid lines) of each polygon were identified and encoded along with other survey responses. These points afforded calculation of polygon length and location. Polygon sizes ranged from 1 grid point to 83 grid points (distance between adjacent grid points represents .59 miles) with a mean polygon size of 15.9 grid points (measures of central tendency presented represent landowner responses). However, the mode size was only 7 points or approximately 4.13 miles, with 1 to 7 point polygons representing 35 percent of respondents. Fifty percent of the respondents had polygons of 10 grid points or less, enclosing approximately 5.9 miles or less or one (1) inch on the map provided (see figure 4). Thus it appears that users indeed tried to be highly specific and were in all probability constrained by the instrument rather than by their spatial knowledge of the riverway.

Historically the limitation on user-generated polygon data albeit most user-generated data with spatial properties, was the number of hand overlays that could be competently interpreted. With an excess of 1000 polygons requiring analysis, an algorithm which associated their spatial characteristics was developed. This in essence is represented by the assignment rule:

$$P_{ij} = P_{ij} + 1$$

where $j = 1, \ldots, N$ individuals and $i = b, \ldots, t$
b = bottom box or polygon code (limit 83, 1 grid lines)
t = top box or polygon code (limit 83, 1 grid lines)
conditional to $b < t$
(N in our example was the 261 landowner respondents).

IMPLICATIONS

The Lower St. Croix and Mississippi River (Becker 1978) studies exhibit the ability and technologies which exist to understand human use on our natural areas. We can analyze individuals' reactions and qualitative perceptions of the resource, such as beauty, yet we continue to view our resource as a monolithic unit separate from other resource areas with users and use levels something that happens to the area rather than something that happens due to the area. We manage (or at least attempt to manage) for scenic quality or beauty under the assumption that quality of environment for an area is a universal amenity (an assumption that may require examination).

The Concept of Displacement (and Substitutability)

As the prefix implies, displacement is a move away from an unacceptable situation, rather than a move toward an acceptable one. Thus displacement and substitutability are related concepts in that the amount and rate of displacement may be modified by the availability of substitutable experiences and resources. Adjustments of use both in time and space are involved.

A number of river studies (on the Colorado, Shelby and Nielsen 1975; Brule, Heberlein and Vaske 1977) have shown that at any given point in time, on any river, the majority of users will say they are satisfied with their experience. That is, in a one-time site-specific experience study, the dominant response will be yes, we are satisfied. Simply by being at that river, the majority are accepting the situation at that site at that time.

It is to be expected that most of the minority who express dissatisfaction with their experience will eventually do something about it. Identified from other studies, possible responses to dissatisfaction are changing the day or time of day of a visit, changing the location on the river of the visit, changing rivers, and, changing activities entirely, i.e., no longer boating. So the question is no longer "who is satisfied now with their experience on a river," but "are those who are satisfied now the same group who were satisfied five years ago on this site -- and, if not, where have these people come from and where have the others gone?" To answer such questions, one-river studies must be tied into the context of other similar rivers in the same region and thus into the concept of movement behavior, or displacement.

If, as in the case of the St. Croix, there is another substitutable river (the Upper Mississippi) within a reasonable distance relative to travel time and cost, users may change rivers altogether. In fact, in the presence of a relatively nearby substitutable river, users may often make this change first. In the absence of a substitutable river, users may more slowly make the other changes in time and space.

The theme of user displacement was a central focus of the regional questionnaire. It was hypothesized that displacement occurs successively to varying degrees. As use increases those users who are density sensitive adjust their use in various ways. The regional survey posed a series of questions aimed, in part, at determining what displacement moves, if any, were occurring on the Lower St. Croix and the Upper Mississippi.

The results of the regional survey suggest that displacement in both time and space is occurring on the Lower St. Croix, in relationship to the Upper Mississippi. Respondents from the St. Croix reported that they had avoided weekends and holiday use periods: a majority said they have attempted to avoid crowds by selecting a time they thought the fewest people would be on the river; half have used a section of the river they knew was not crowded; 6 percent have used other rivers altogether, including the Upper Mississippi.

It has been established that users of the Lower St. Croix and the Upper Mississippi were equally satisfied with their visits to these rivers. Other results from the regional survey indicate that these different relationships found between satisfaction and the perception of crowding on the two rivers suggests that Upper Mississippi users (1) expect to see fewer people and (2) are more sensitive to crowding than Lower St. Croix users. A possible explanation for the relationship between perceived crowding and level of satisfaction may be that current Upper Mississippi users are simply more density sensitive than those currently using the Lower St. Croix. The St. Croix users who were not sensitive may have displaced to other rivers, including the Mississippi. Those Upper Mississippi users responding to the regional survey who formerly used the Lower St. Croix cited crowding (63 percent) as the dominant reason for their displacement. (Less than .1 percent of those using the St. Croix who had formerly used the Upper Mississippi cited crowding as a reason for leaving.) As use levels increase, it is likely that this pattern will continue.

When asked to rank a number of rivers they had used for a series of characteristics, those surveyed from both rivers ranked the Upper Mississippi as the "least crowded" with the best overall recreation experience. The Lower St. Croix was similarly ranked as the "most beautiful" and having the best environmental quality. A shift of users from one river nationally designated "wild and scenic" and deemed to have a better resource quality to another deemed to have a better overall recreation experience (including less crowding) and poorer visual quality, may indicate that, for those who spatially displace themselves, the desired experience itself is a more driving factor than the aesthetic quality of the setting. Thus while we can determine characteristics and spatial locations that individuals describe as beautiful and, while we can manage to protect or enhance these characteristics, a fundamental question of "beauty for what?" must be incorporated into any management plan. The concept of visual quality or landscape quality requires definition in a context of user perceptions and expectations for a desired experience associated with that resource. If user density expectations of beautiful areas are not included into the measurement of beauty will there be much beauty to enjoy?

EPILOGUE

On October 4, 1978, the Lower St. Croix Management Commission resolved the following:

> Whereas, the Final Master Plan for the Lower St. Croix National Scenic Riverway establishes some uniform policies and recommends 'a definitive research study should be undertaken...to determine the optimal carrying capacity... to identify resource constraints, facility capacities, and...socio-esthetic values. Any future access expansion, site development, and water or land zoning would benefit from such guidelines...and,
>
> Whereas, such a definitive study was conducted by the University of Wisconsin-Madison during the summer of 1977...and,
>
> Whereas, said study...shows clearly that water based recreational use of the Riverway is rapidly increasing and causing crowding, potential serious safety problems, conflicts between users and riparian landowners, and seriously reducing resource quality. (Lower St. Croix Commission 1978, pp. 1-2).

The outcome of this resolution(s) remain in doubt. The managers seem unwilling to acknowledge that the question of "optimal carrying capacity" is also social capacity and not solely a resource capacity question. As stated by a Commission of the Minnesota Department of Natural Resources:

> I'm saying that this river (Lower St. Croix) belongs to all of us and we should by the expertise that's represented here at least admit that we have the ability to manage the river to the point where it won't be (physically) degraded. (Lower St. Croix Commission 1978, pp. 14-15).

The eventual experiental future and the "beauty" of the Lower St. Croix may be decided shortly. A new marina development permit has been applied for by a developer. How will the managers respond?

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A Visual Resource Management Study of Alternative Dams, Reservoirs and Highway and Transmission Line Corridors near Copper Creek, Washington[1]

John Ady, Brian A. Gray and Grant R. Jones[2]

Abstract: Three alternative dams have been considered by Seattle City Light for the Skagit River Narrows in the North Cascades National Recreation Area, Washington. The authors assessed the area's existing visual resources, identified three alternative highway and transmission line realignments, evaluated changes in visual character and quality for 13 different combinations of reservoirs, roads and powerlines, and recommended alternatives and mitigation opportunities. These combinations were simulated on "before" and "after" oblique aerial color photographs which facilitated visual impact evaluation. The loss of visual quality after development was generally small in comparison to the dramatic change in visual character. The study proved valuable for presenting impacts credibly to both client and public groups. It also demonstrated the parity of visual assessment with other assessments.

INTRODUCTION

Effective visual resource management involves three distinct realms: 1) a landscape setting, 2) viewers of that landscape, and 3) the planning process. The visual resource manager must function well within each realm; in such a central position, he[3] has a special responsibility and opportunity to move between realms and serve on behalf of all.

First of all, the visual resource manager must know the landscape setting: familiarity with its geology, climate, physiography, soils, water forms, vegetation, wildlife, settlement patterns, historic development, land use activities and future trends is a prerequisite to a true understanding of the natural and cultural processes which give form to the landscape (McHarg 1969; Jones 1973 and Spring 1975). To this knowledge he must add an objective assessment of the visual character and quality of the setting, the relative uniqueness or scarcity of its resources within a local, regional and national context, and the setting's ability to absorb visually various types of land use patterns over time. Since the landscape setting is not vocal (a disadvantage in dealing with the other two realms), the visual resource manager must know the landscape intimately and serve as its representative, speaking for it and intervening in its behalf. The manager must be able to determine and document pertinent quantitative and qualitative information about the landscape setting: for example, what is unique about a particular setting, what is similar and held in common with other settings, and the significance of any uniqueness within a larger context.

Secondly, the visual resource manager must become familiar with the viewers who frequent a particular landscape setting. He must know its actual visibility to them, including frequency and duration of view. He must also know viewer positions within the setting, their numbers, movement patterns, activities, and expectations of visual quality and character in the landscape. He must be able to identify groups of viewers, and their likely sensitivity to a proposed alteration on the basis of this information. He must know how to communicate the actual appearance of an alteration to the viewers, and how to elicit meaningful responses from them so that he can make recommendations about a proposed action in a way that best represents actual viewers' interest and concerns.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Associates and Partner, Jones & Jones, Seattle, Washington.

[3] The word "he" is used to refer to the visual resource manager, regardless of gender.

Thirdly, the visual resource manager must understand the planning process, comprehend all the visual ramifications of a particular project and be able to simulate its appearance accurately from key viewpoints. Even if personally opposed to one or more alternatives, the visual resource manager must often play the role of advisor or even designer, clarifying or giving intelligent form to a project so that visual impacts are properly depicted and assessed. He must therefore be creatively active within the planning process, knowing project requirements and offering visual resource management guidelines from which reasonable alternatives can be developed and mitigating measures determined. He must be able to communicate with clients, other planners, government agencies, and the public.

Then, the visual resource manager will be capable of integrating all three realms - landscape setting, viewer concerns and planning process - in a meaningful way. In 1978, the authors received the opportunity to play such a role as subconsultants to CH2M Hill, in order to assess the potential visual impacts of Seattle City Light's proposed hydroelectric dam on the Skagit River near Copper Creek. Jones & Jones assessed the visual resources of the landscape setting in its regional context, determined environmental and functional guidelines and actually generated highway and transmission realignment alternatives. They also presented simulated views of these alternatives to planners and clients, conducted limited workshops, and evaluated the types and degrees of visual impact for each alternative. Finally, they were able to suggest mitigating options and made recommendations based on visual impact concerns.

This undertaking is documented in the technical report on the Scenic Environment in the Copper Creek Environmental Assessment (Ady 1979). Following procedures similar to those presented in the FHWA "Esthetics and Visual Resource Management for Highways" course (Jones and Jones 1978), this study illustrates the application of this method for highway location and its transfer to dams, reservoirs and transmission lines. It assumes that the visual quality of landscapes before and after change can be evaluated and compared by professionals using explicit criteria to reduce preferential bias and to anticipate ratings by the general public. These evaluations are modified by the relative scarcity of the resources and the numbers, exposure and sensitivity of the viewers.

EXISTING VISUAL CONDITIONS

The Skagit River Valley in northwestern Washington is remarkable for its variety of largely unspoiled landscapes from mountain passes to delta and the clarity of their relationships, all visually accessible to cross-state travelers. The Skagit Narrows runs southwest for 9½ miles from Newhalem Village to the boundary of Ross Lake National Recreation Area, a transitional gateway between the rugged mountainous upland and the open pastoral valley downstream.

Spatially, the valley is a lowland floor lying between steep forested walls, combining intimate riverside diversity with grandeur of scale. The Narrows reach contains three runs based on major spatial subdivisions: Upper Narrows, Central Narrows and Lower Narrows. Within these are six visually distinct landscape units or "rooms" (see figure 1).

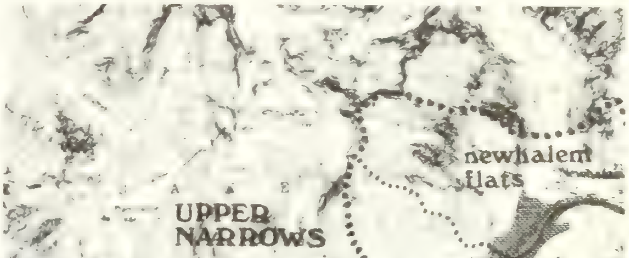

Figure 1--*Dam locations and landscape units.*

The main landforms within the valley include floodplain (which would be inundated by a reservoir), river terraces, small alluvial fans, and steep valley walls, with a discontinuous shoulder on the north wall. The floor of the Narrows drops 130 feet in ten miles, which creates the last remaining white-water on the Skagit. The diversity of channels and shorelines is high; there are many small mountainside streams and 30 acres of gravel-pit ponds. A rich mixed lowland forest covers the valley floor, with a dense coniferous forest clothing the valley walls. Manmade development is not extensive except for the dominant highway and powerlines.

LANDSCAPE VISUAL SIGNIFICANCE

The project area is unique: a) in being within Ross Lake National Recreation Area, b) in containing the only major free-flowing river within the North Cascades National Park Complex, including the last rapids on the Skagit, and c) in its character of narrow lowland valley floor fingering deeply into the mountains. Regionally, the Narrows Reach is comparable to certain reaches of five other major rivers in similar valleys in the northwest Cascades. Of these, the Skagit River has the largest drainage basin and highest stream flow, making it the largest river of its kind in northwestern Washington. Locally, the Narrows reach is an important entry corridor, mixing lowland recreation opportunities with mountain-related uses.

VIEWER GROUPS

Three major and two minor groups view this landscape. Cross-state travelers along Route 20 (a designated scenic highway) form the largest group, averaging 38,580 trips per month in 1976. These transient viewers are highly responsive to the scenery. Campers at Goodell Creek totalled 10,046 in 1977, mostly between May and October, and are also highly concerned with landscape appearance; their numbers will increase when the new 436-unit Newhalem campground is built. The 250 residents of Newhalem (a community of Seattle City Light employees and their families) view the area year-round. There are also rafters, boaters and fishermen on the river, and some hikers. The area's designation as part of the Ross Lake National Recreation Area increases viewers' expectations of its landscape, and its gateway character heightens their awareness of it as a place.

PLANNING ALTERNATIVES

Alternative Dams

Three alternative dams are being considere by City Light (figure 1):

- Copper Creek high dam: 495-foot pool elevation, flooding 2,200 acres of vall floor, 9½ miles long.
- Copper Creek low dam: 480-foot pool elevation, 1,700 acres, 9 miles long.
- Damnation Creek high dam: 495-foot pool elevation, 1,500 acres, 7 miles long.

Alternative Road Alignments

Since the reservoirs would flood 7 to 10 miles of State Route 20, four alternative road realignments were developed (three by Jones & Jones and one by the State Department of Highways). In locating these routes, the four main visual management principles of protection, enhancement, conservation and mitigation helped to develop specific planning criteria. These included the functional criteria of utility, safety and economy. The environmental criteria were compatibility with the NRA (protection), enhancement of the traveler's experience of the landscape, and minimal environmental and visual impacts (conservation and mitigation).

The alignments lie in one corridor on the lower north wall of the valley, and all would require large cuts and fills (see figure 2). All were designed as two-lane 50 m.p.h. roads. Steepness of slope proved the key locational criterion, and slight benches in the landform were often used to locate the hillside roads. Overall length and steep grades were minimized. A balance of cut, fill and structures was worked out for road siting on each category of slope. Minimal grading scars with maximum screening by topography and vegetation were intended; alignments were also chosen to reveal the valley main features and views to travelers.

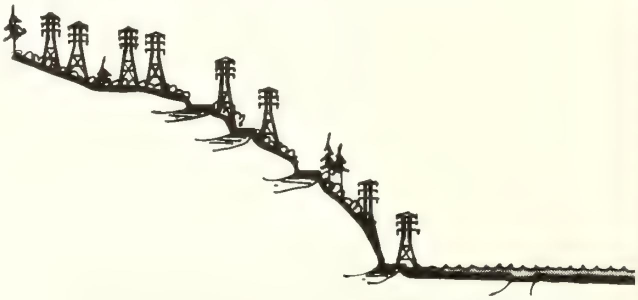

Figure 2--*Road and transmission line location alternatives.*

The four alternative road realignments and their objectives are:

- o High road (high point 1,000 feet above the lake): minimize impacts on the lake and use a hillside bench to reduce grading. Over half the length of road would run in forest, screening both road and outviews.
- o Middle road (300-500 feet above the lake): maximize views of the valley and mountains. This alignment uses a discontinuous shoulder in the landform but involves much conspicuous grading.
- o Lakeshore road(s): provide visual access to the lake and valley floor and avoid climbing. This alignment would impact the lake heavily. The Department of Highway's design (480-foot pool level) involves extensive fill along the lake edge, and is one mile shorter.

Alternative Transmission Line Alignments

The reservoirs would also flood sections of the existing powerlines. Three alternatives, high, middle and low (or "existing") alignments were developed (figure 2), each above and roughly parallel to a highway alignment. Each would be a double-circuit 230 kV line with a 200-foot right-of-way. The location criteria included environmental protection (minimal visual impact, minimal disruption to natural ecosystems and forests), compatibility with land use (minimal disruption to existing and projected settlements and recreational lands) and engineering feasibility (maximum utilization of existing right-of-way, system accessibility, and economy).

PHOTOGRAPHIC SIMULATIONS

Visual resources and project proposals were illustrated in a comprehensive series of before-and-after views comparing various combinations of alternatives (see color plates, figure 6*). To locate the potential lake level (up to 105 feet above the existing forested ground level) on oblique aerial photographs, Jones & Jones tethered several red 4-foot diameter helium-filled weather balloons along the riverbanks of the proposed pool elevation and photographed the valley from a helicopter from 2,000 feet, 500 feet and potential lake level. Viewpoints were chosen with the intention of approximating views from various road positions, the lake surface and from the proposed Newhalem campground. To facilitate accurate depiction of alternatives as seen from each viewpoint, we employed a "modelscope" to photograph a model of the valley showing alternative lakes, roads and transmission lines from the same viewpoints. (The modelscope is a periscope lens attachment which can easily reach actual viewpoints in a model.) These data were collected on hand-drawn perspective overlays, to which was then added cuts, fills and other details. These drawings were delivered to an artist who airbrushed the enlarged color photographs to simulate alternatives. Use of these illustrations to summarize potential impacts, evaluate the visual quality of alternatives, and present these to client and public amply justified their expense.

TABULATION OF VISUAL CONDITIONS

To facilitate the inventory and evaluation procedures, scores were recorded in various tables. Since these are referred to in the following sections, this will serve as an introduction. A tabulation of visual resources before and after project development is excerpted as figure 3--*Visual resources before and after development*, which considers the overall supply and expression of visual resources at each of the six individual landscape units of the Narrows, both existing and as generally affected by any dam, reservoir, road and transmission realignments. Figure 3 is essentially concerned with the detailed visual character of each unit in response to the overall project.

Figure 4--*Selected visual impacts*, recombines all six units back together into the Narrows reach as a whole, and compares the various combinations of alternatives (only a few are shown here) as each combination would influence the visual character and visual quality of the Narrows: a) as a total valley (i.e. as viewed from an overall vantage point), b) as viewed from the road, and c) (not pictured) as viewed from the water. Probable viewer response for travelers along the road is also tabulated; all scoring methods will be discussed below.

Figure 5 verbally summarizes all the visual impacts in the Narrows for each combination of alternatives (again, only a few are shown here), considering the changes in visual character, visual quality and impact on viewers, once again relative to the a) total valley, b) view from the road, and c) view from the water.

VISUAL CHARACTER

The visual character of a landscape can be described by the form, line, color and texture of the landform and landcover patterns composing it and their relative dominance, scale, diversity and continuity. The visual resources of each landscape unit of the Narrows were inventoried in a table excerpted as figure 3, within six

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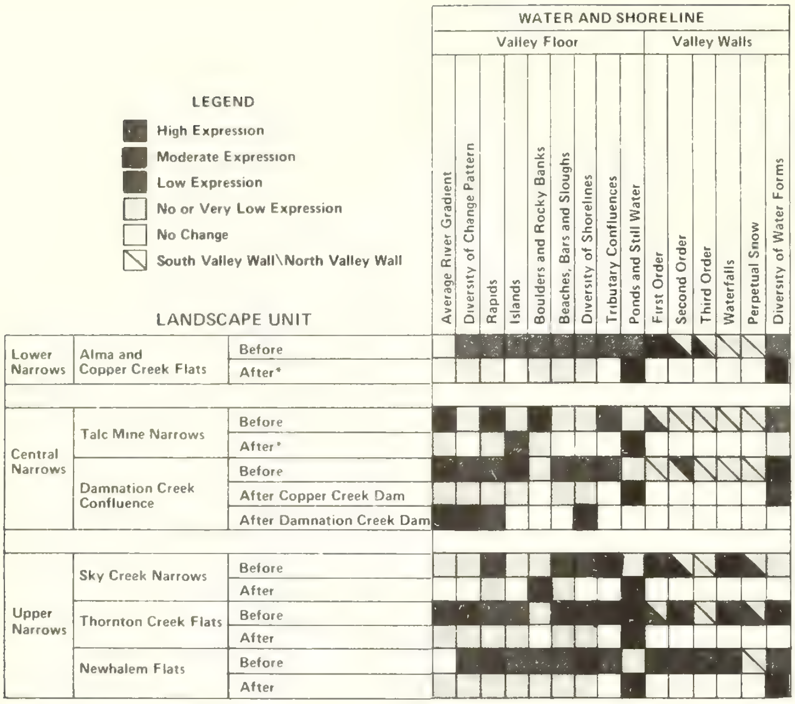
*See color illustration on page 397.



* Copper Creek alternatives only

WATER AND SHORELINE	☐	■	■	■
Average River Gradient	10'/m	15/mi	20'/m	20'/m plus
Diversity of Channel Pattern	Low	Mod Low	Mod High	High
Rapids	Absent	Present	Mod Prominent	Very Prominent
Islands	Absent	Present	Mod Prominent	Very Prominent
Diversity of Shoreline	Very Low	Mod Low	Mod High	High
Beaches Bars and Sloughs	Absent	Present	Mod Prominent	Very Prominent
Boulders and Rocky Banks	Absent	Present	Mod Prominent	Very Prominent
Tributary Confluences	Absent	1 3/mi	3 5/mi.	5/mi. plus
Ponds and Still Water	Absent	Present	Mod Prominent	Very Prominent
Valley Walls				
First Order Tributaries	Absent	1 2	3 5	5 plus
Second Order Tributaries	Absent	1 2	3 5	5 plus
Third Order Tributaries	Absent	1 2	3 5	5 plus
Waterfalls	Absent	Present	Mod Prominent	Very Prominent
Perpetual Snow	Absent	Present	Mod Prominent	Very Prominent
Diversity of Waterforms	Low	Mod Low	Mod High	Very High

NOTE: water and shoreline visual resources are shown here. Categories not illustrated include spatial definition, landform, vegetation patterns, wildlife visibility and manmade forms.

Figure 3--*Visual resources before and after development.*

Figure 4--*Selected visual impacts.*

VH	1	Very High
H	2	High
MH	3	Moderately High
M	4	Moderate
ML	5	Moderately Low
L	6	Low
VL	7	Very Low

		TOTAL VALLEY												VIEW FROM ROAD															
		CHANGE IN VISUAL CHARACTER								VISUAL QUALITY (From Figure 7)					VISUAL QUALITY							VIEWER RESPONSE							
		LENGTH OF VALLEY AFFECTED (mi.)	Space	Landform	Water	Vegetation	Wildlife	Manmade Forms	TOTAL CHANGE IN VISUAL CHARACTER (Av Water weighed x3)	VQ BEFORE	VQ AFTER	RATIO OF CHANGE IN VQ	RATIO OF CHANGE 1 7 *	CHANGE IN VISUAL CHARACTER	Vividness	Intactness	Unity	VISUAL QUALITY (AV)	VQ 1 100		RATIO OF CHANGE 1 7	Viewer Awareness	Viewer Expectation	VIEWER SENSITIVITY	Water	Road	Transmission Line	VISIBILITY OF ALTERATION	VIEWER RESPONSE
Existing Conditions										31	Mod High				3	3	2 3	2 76	30	Mod High		MH	H	H	MH	ML	H	MH	High
COPPER CREEK DAMS																													
High Road and Lake	High Transmission Line	10 mi	M	H	VH	H	MH	MH	High		31	0	None	H	2 5	2 3	2 0	2 3	23	+ 23	+ Low	H	H	H	M	ML	L	ML	Mod High
	Mid Transmission Line	10 m	M	H	VH	H	MH	MH	High		35	13	Very Low	H	2 5	2 6	2 6	2 7	27	+ 10	+ Very Low	H	H	H	M	ML	H	M	Mod High
	Low Transmission Line	10 m	M	H	VH	H	MH	MH	High		34	12	Very Low	H	2 5	2 5	2 4	2 46	25	+ 20	+ Low	H	H	H	M	ML	L	ML	Mod High

Figure 5--*Summary of visual impacts.*

NOTE: Not all alternatives are tabulated here.

		SUMMARY OF IMPACTS									
		TOTAL VALLEY		VIEW FROM ROAD				VIEW FROM WATER			
COPPER CREEK DAMS		CHANGE IN VISUAL CHARACTER	CHANGE IN VISUAL QUALITY	CHANGE IN VISUAL CHARACTER	Ratio of Change in VQ	Viewer Response	IMPACT ON VIEWERS	CHANGE IN VISUAL CHARACTER	Ratio of Change in VQ	Viewer Response	IMPACT ON VIEWERS
High Road and Lake	High Transmission Line	High	None	High	+ Low	Mod High	+ Moderate	Very High	Very Low	Mod High	Mod Low
	Mid Transmission Line	High	Very Low	High	+ Very Low	Mod High	+ Mod Low	Very High	Mod Low	High	Mod High
	Low Transmission Line	High	Very Low	High	+ Low	Mod High	+ Moderate	Very High	Moderate	High	Mod High
Middle Roads and Lakes	High Transmission Line	High	Very Low	Very High	+ Low	High	+ Moderate	Very High	Moderate	Mod High	Mod High
	Mid Transmission Line	High	Very Low	Very High	+ Very Low	High	+ Moderate	Very High	Mod High	High	High
	Low Transmission Line	High	Very Low	Very High	Very Low	Very High	+ Moderate	Very High	High	High	High

categories: Spatial Definition, Landforms, Water and Shoreline (shown here), Vegetation, Wildlife Visibility and Manmade Forms. The degree of visual expression of each resource within each landscape unit is indicated by a gray scale.

The change in visual character of the Narrows as a whole for some of the alternatives is given in figure 4. Under the heading of Change in Visual Character, the degree of change in each major component of the landscape for each alternative combination of dam, road and powerline was summarized as seen both from the road and from the lake, and judged on the conformity of its patterns and the blend of its character with its surroundings.

The valley floor would be almost completely flooded, but the south wall barely affected except at the dam. The upper north wall could best be spared encroachment if the road and powerlines were sited along the visual seam of the lakeshore edge. The major visual loss would be of the intimacy and diversity of the lowland valley floor, the river and the rapids, which would be replaced by the lake with its drawdown edge and the new structures, road and powerline units along the shore or north valley wall. This loss would be somewhat offset by the visual advantage of a lake, increasing the openness of the view, the drama of the enclosing walls and the unity of the valley. The high Copper Creek reservoir would have a similar effect to the low, except near Newhalem where it would flood about 200 acres more of the valley floor. The Damnation Creek reservoir being smaller would change the character of a proportionately smaller area, and would preserve one last series of rapids just downstream from the damsite.

VIEWER RESPONSE

While there are infinite variations in individual responsiveness to the landscape, by and large groups of viewers can be identified according to their activities, movement patterns, and conditioned expectations. The five viewer groups previously discussed can be associated with one or both of two main viewing positions: view from the road (SR 20) and view from the water (river/lake surface and campground).

Primary measures of a viewer's response to landscape include his sensitivity to it and its visibility to him. *Viewer sensitivity* is comprised of two factors: the viewer's awareness and expectations (Vaughn, N.D., Hendrickson 1974).

Viewer awareness depends on viewer activity and location. Performing a certain activity will affect a viewer's ability to perceive the landscape, bringing him to focus on it or distracting his attention. Location also may affect a viewer's awareness, especially at overlooks, "first view" points and in transitional landscapes such as the Narrows, the gateway between an open valley landscape and mountainous gorges.

Viewer expectation is a measure of a viewer's preconceptions about a landscape's character or quality. In the Narrows, the reputation of the rapids, the area's designation as NRA and national park with a major campground, and the state scenic and recreational highway designation for Route 20 will elicit higher viewer expectations than would undesignated areas.

Visibility of Alteration depends on the degree of exposure the alterations would have from the main viewpoints, and includes consideration of the number of viewers present and the duration and proximity of the view of such alterations as reservoir, road and transmission line realignments. In this study the view from the reservoir paralleling the highway is accorded equal weight with the view from the road.

In the excerpt quoted in figure 4, overall Viewer Response is obtained by combining the scores for Viewer Sensitivity and Visibility of Alteration, expressed on a four-point scale.

VISUAL QUALITY EVALUATION

An established procedure for visual quality assessment, first developed by the authors and applied successfully to a wide range of projects and landscape settings (Jones April 1975), was applied to the Narrows to determine changes in visual quality that would result from each combination of project alternatives. Rather than depend on a single overall appraisal of visual quality (which can often be affected by individual preferential bias), three specific criteria are rated separately which, when averaged, yield visual quality scores which are stable and diminish preferential bias. These scores closely correlate with the mean visual quality ratings of design professionals (and by inference, the general public[4/]) for a given landscape scene, and are useful in determining the qualitative strengths and weaknesses of a scene or a design alternative.

[4/] See Blair (1976) for comparison of visual compatibility scores across various viewer groups.

The criteria used to evaluate visual quality are Vividness, Intactness and Unity.

> *Vividness* (Litton 1971 and Jones April 1975) is a measure of the memorability and distinctiveness of the landscape as experienced from the visual diversity and contrasts expressed in its main components, spatial form, landform, water, vegetation, wildlife and manmade form.
>
> *Intactness* (Jones 1973 and Zube 1973) is a measure of the apparent visual integrity of the natural and manmade orders in a landscape: its freedom from visual encroachments.
>
> *Unity* (Litton 1971 and Jones April 1975) is the measure of the degree to which natural and manmade elements of the landscape are compatible and form a harmonious and coherent visual whole.

Each criterion is applied to a landscape or view and can be measured on a scale from 1 (very high) to 7 (very low), summed and averaged to give an evaluation of visual quality:

$$\text{Visual Quality} = \frac{\text{Vividness + Intactness + Unity}}{3}$$

For easier comparison the scores from this equation are converted to a scale of 1-100. The ratio of change in visual quality is also given, bracketed into seven ranges of scores from very low to very high. See figure 4 for examples of visual quality score tabulations.

CHANGES IN VISUAL QUALITY IN THE VALLEY AS A WHOLE

For the valley considered as a whole, the existing visual quality of the Narrows (averaged along its length) is on the high end of the moderately high range (31 on a 1 to 100 scale, 1 being highest). This overall rating would decline only slightly to 31.7 with the Damnation Creek dam, and to 34.5 with the Copper Creek dam. On the whole, the vividness of the lake would be higher than the existing river but the intactness of the valley would decline due to structures, right-of-way corridors, drawdown and cuts and fills. The visual unity between manmade and natural features would be somewhat less for the same reasons, but the vivid lake would compensate by enhancing the overall visual unity of the valley. Damnation Creek dam would preserve about a third of the existing valley and river as well as provide a lake, so the overall visual quality of the valley with this alternative would be somewhat higher than with the Copper Creek dams.

The differing visual effects of the alterr- tive roads and powerline locations are summariz for the valley as a whole. Both corridors woul form a vivid line on the hillside, more marked with the midslope corridors and separated right of-ways, less so if one corridor were high and the other at the foot of the slope. If the corridors were sited at the slope foot, the valley wall would be unaffected at the cost of visually encroaching on the shoreline and the lake, with traffic noise and movement, and of continually seeing the powerlines overhead fror the road. The combination of causeway riprap with drawdown would aggravate this condition.

CHANGES IN VISUAL QUALITY IN THE VIEW FROM THE ROAD

The visual quality of the view from the ne road (in comparison to the view from the existi road) would be improved for most alternatives, except for the lakeshore roads where they run under powerlines, and for the middle road with powerlines located between it and the water. Vividness would increase with exposure to the valley and the lake, especially from the middle roads, the high road being more screened and the low roads having less variety of scene. The intactness of the view from the road would decrease where roads are seen to cut across the hillside, where powerlines interrupt the view to the lake or, especially, where powerlines an the road's cuts, fills and causeway encroach on the shoreline. The unity of the scene would be best preserved where transmission lines are screened by topography, trees, or distance, especially in the high location, least well alo the lakeshore.

Viewer expectations would be high for each road alternative, peaking at both ends of the valley. Viewer awareness would be highest where long views are most evident. With Damnation Creek dam, the view from the road would be more diverse, less impacted by transmission lin and thus of higher visual quality.

CHANGES IN VISUAL QUALITY IN THE VIEW FROM THE LAKE

The visual quality of the view from the proposed lake (compared with the existing view from the river) would decrease markedly because of the higher degree of encroachment from roadc and transmission lines. The vividness would st be very high, especially with the lakeside road The intactness would decrease where roads or powerlines impact the lakeshore or gash the hillside, more so with the middle than with the high alignment, which is screened by distance, topography, and vegetation. The unity of the view from the lake, owing to these intrusions, would be less than that of the existing view from the river. Alternatives which preserve the visual integrity of the hillside and the shoreline (the upper road and transmission line positions) would provide the highest visual unity as viewed from the lake. Both the expectations and awareness of the viewers from the lake would be high. With Damnation Creek dam, the view from the remaining river would not be badly impacted but would not be made accessible, so that the view from the lake would remain the main viewpoint.

SUMMARY

The project would destroy the visual diversity of the existing valley floor, but would provide some visual compensation for these losses in the creation of a lake. There would be dramatic changes in the visual character of the valley, but its visual quality would be only slightly diminished. As experienced as a whole and as seen from the proposed lake, visual quality could be somewhat lower, depending on the selected location of the road and transmission lines; the visual quality experienced from the relocated road could be higher than the view from the existing road.

Final decisions on which alternatives, if any, should be built, are still pending. However, the thoroughness of this examination and the illustration of alternatives proved very useful in presenting potential impacts with credibility to both client and public, and in dispelling prejudice based on lack of information. The study demonstrates the parity of visual assessment with assessments of other major impacts. It also demonstrates that the quantified application of visual criteria to a wide range of illustrated simulations is an accessible, fast and comprehensive way to generate, summarize, evaluate and select alternative solutions to a complex problem.

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Predicting the Visual Quality Impacts of Development: A Simulation of Alternative Policies for Implementing the Massachusetts Scenic and Recreational Rivers Act[1]

Carl Steinitz[2]

Abstract: An implementation work program has been developed by the Massachusetts Department of Environmental Management (MASS D.E.M.) for the Massachusetts Scenic and Recreational Rivers Act, and the North River has been chosen as the pilot project area. The question which has been posed by MASS D.E.M. is: "What will be the impacts of eleven alternative implementation policy scenarios on new development, and thus on the visual qualities of the North River?" Components of the scenarios include building performance standards, zoning changes, and conservation purchases. The Harvard Graduate School of Design (GSD) research team has translated scenarios into model constraints and has tested the effects of these added constraints on housing development and its consequent visual impacts. The policy implications of the results have been analyzed by the author while MASS D.E.M. has had the responsibility for actual public policy. This paper summarizes the study process, findings, and conclusions.

1.0 THE MASSACHUSETTS SCENIC RIVER PROGRAM AND THE NORTH RIVER DEMONSTRATION PROJECT

The Massachusetts Scenic and Recreational Rivers Act was passed by the legislature in 1971 to protect the Commonwealth's irreplaceable river resources. The Commissioner of the Department of Environmental Management is to select rivers and streams for inclusion in a statewide system of scenic rivers. Each scenic river or stream will be protected by regulatory orders specifying conditions for development and other alterations of the river or adjacent land within the scenic river corridor up to 100 yards on each side of the natural bank of the river. These orders will be recorded at the registry of deeds with the property of each owner whose lands fall within this zone.

The demonstration project on the North River consists of a detailed study of the characteristics of the North River and its surrounding watershed to determine the appropriateness of and scope that orders of conditions will take on the river. This study and subsequent implementation process for the river corridor will serve as a model for the designation and protection of other scenic and recreational rivers and streams of the Commonwealth. The outstanding scenic and environmental qualities of the North River, its historical and cultural amenities, and the broac base of support from landowners, citizens, local officials, and regional planning agencies have combined to make the selection of the river as a demonstration project both an appropriate and timely choice. The North River is the major relatively undeveloped tidal river in southeastern Massachusetts. It is located in Figure 1. In an area presently experiencing substantial pressure for development, the river and the surrounding environment still offer an outstanding diverse landscape quality.

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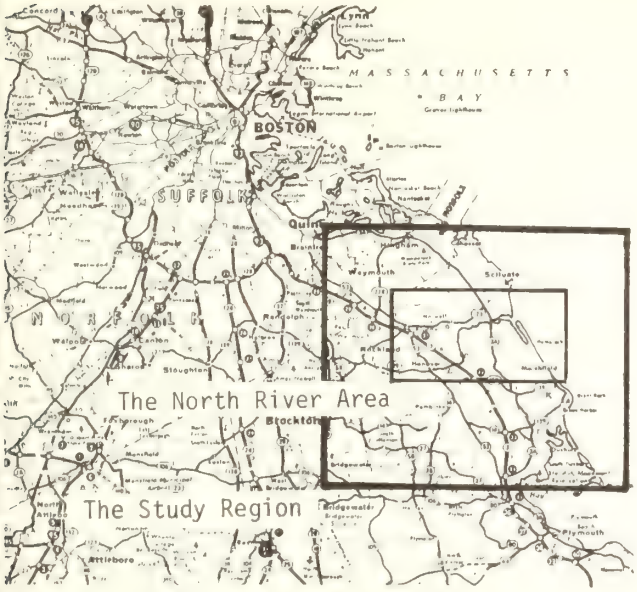
Figure 1 -- Study Area Location Within the Boston Region



The area included in the research program is located in the southeast sector of the Boston metropolitan area. The total data area measures 756 square kilometers (or, at the scale of the data, 75,600 one hectare cells). All of the methods used in this study have been operated on this data base. However, for the purposes of this paper, the figures are presented in a graphic format which focuses on the immediate North River area.

2.0 THE STUDY METHOD

As an integral part of the state's river corridor study, the research team has simulated the effects of various regulatory policy scenarios proposed for the implementation of the Massachusetts Scenic Rivers Act upon the North River. The research team has developed and organized a series of computer models that analyze the processes or urban development, the social, fiscal, and environmental evaluations of these changes, and the legal constraints upon them. These twenty-eight land use allocation and impact evaluation models share technical infrastructure consisting of a computer data base, a variety of spatial and other analysis programs, and a series of computer graphic and other output devices. The intent of the research was not to develop a single model, but a series of discrete, yet interrelated models that could be combined in a number of ways depending on the kinds of information desired, or the type of policy questions being addressed. In the proper combinations, the models may be used for such tasks as planning-simulation, projection, plan evaluation, gaming, optimizing and the exploration of new legal and implementation tools. The models have been used to address growth-related issues in the study area in a series of workshops and case studies (Steinitz and Brown 1977).

For the issues addressed by this study, two of the models have been used. A series of alternative policy scenarios have been designed and used as constraints to the allocation of new housing by the Housing Model. The resulting development patterns have then been comparatively evaluated for their visual impacts on the scenic river by the Visual Quality Evaluation Model.

2.1 The Housing Allocation Model
(Brown and Wilkins 1979)

Given expected regional demands[3], the dominant component of development in the North River will continue to be new housing. The Housing Model attempts to simulate the working of the market mechanism to determine the future residential development pattern. The basic assumption of the model is that developers choose sites which maximize the profits from development. The model allocates twelve types of houses to sites so as to achieve the maximum rate of return on investment for the developer. At the same time, the mix of houses built must satisfy the demand and the land developed must not exceed the capacity of available land. The model allocates a total of seven single family and five multiple-family structure types, each distinguished by their floor area and construction quality. There are four major submodels, the Development Cost Submodel, The Sales Price Submodel, The Housing Demand and Supply Submodel, and The Allocation Submodel.

Data on a large sample of housing transactions were collected from within the study area and have served as the basis for the calculation of the Sales Price Submodel (Li and Brown 1978). The difference between the expected selling price and the development cost divided by the cost gives a measure of the rate of return which is shown in Figure 2 for large one acre single family housing in the North River area. The darker areas show cells from which the developer will receive the

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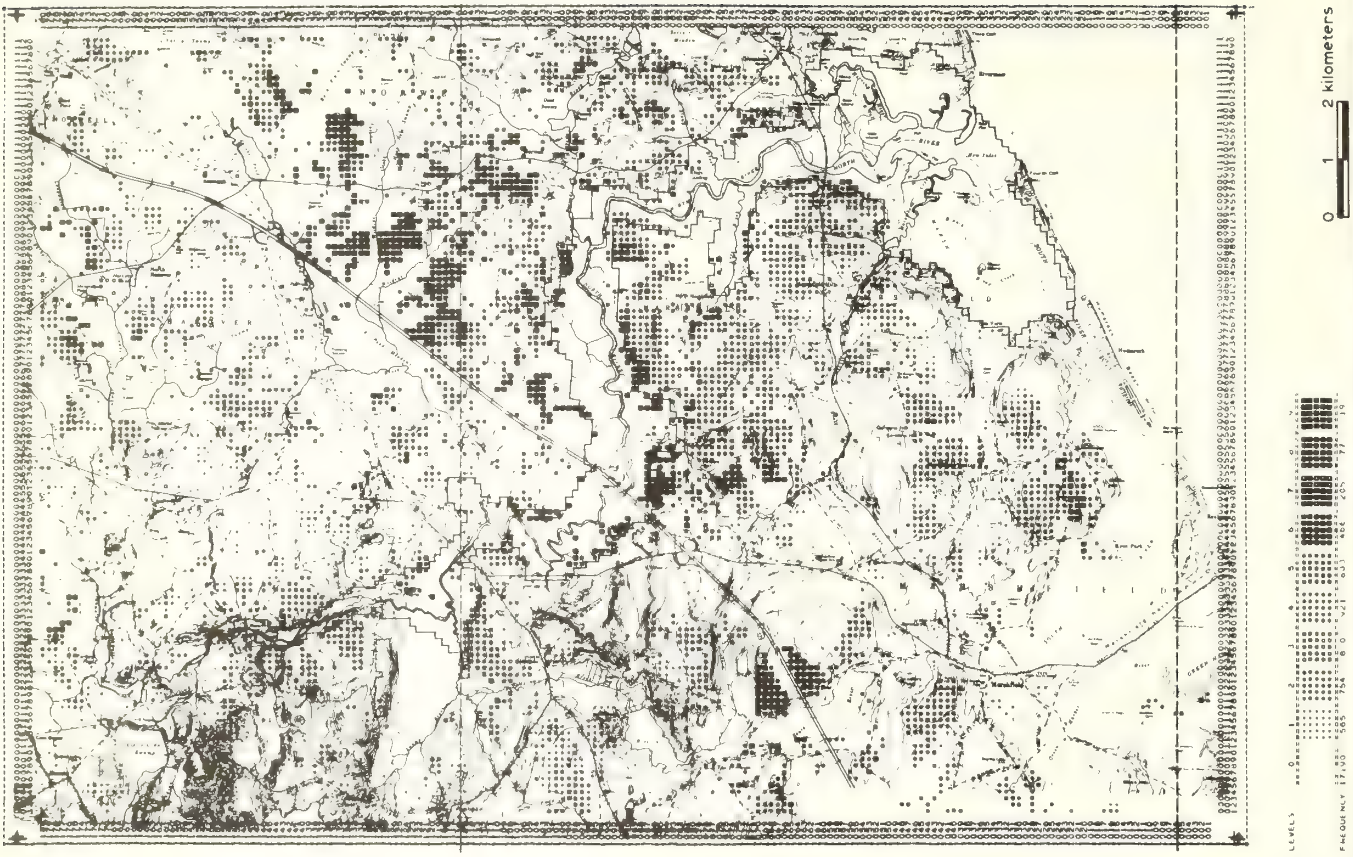
[3] For these scenarios we used ten and twenty year population increases based on an interpolation of state and federal predictions for the study region; 42,500 between 1975-85 and 49,000 between 1985-95.

Figure 2 --Rate of Return
Type 2, Single Family Housing
one unit per acre



highest rates of return. A similar calculation is made for all other structure types. The location of new housing is determined in the Allocation Submodel. The rates of return for each housing type for each developable cell are ranked in descending order. The highest return activities are assigned for development as long as the demand for the housing type has not already been satisfied by earlier assignments, the cell has not already been assigned to another housing type, and the activity does not violate local zoning. The list of ranked activities is examined until none will satisfy any of the tests.

2.2 The Visual Quality Evaluation Model (Steinitz 1979)

Once the land use pattern is altered by the new development allocated by the Housing Model for 1985 and 1995, the Visual Quality Model is used to evaluate the impact of that change on the scenic character of the study area. The model postulates that the visual quality of an area (or the visual impact of change) is to be evaluated in terms of how people perceive and "like" what they see as they look from the places in which they are located.

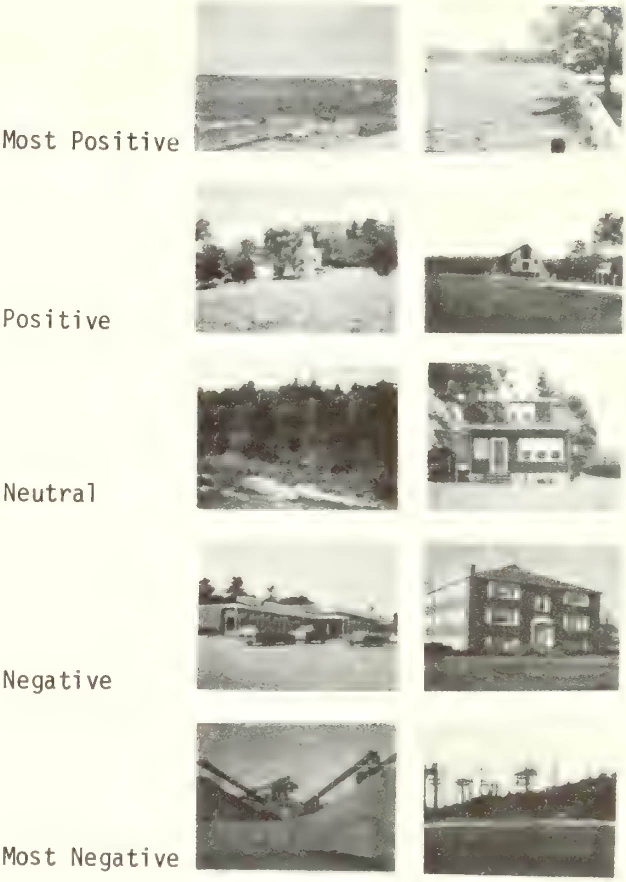
The Visual Quality Evaluation Model has two basic stages: description and evaluation. The first includes the identification of the intervisibility of places (the pattern of what can be seen from any cell of group of cells), and is accomplished with a flexible searching process. The model requires the user to provide the locations of views to be analyzed, the visually dominant land use and land cover types of each hectare cell, and data files which describe the visual topography (including various height and blocking factors associated with land use and land cover). In its descriptive output, the visual quality analysis model describes the area seen from view origins in terms of what area and what types were seen and how much these were visible.

The pattern and content of the area seen from any view origin cell are established through a computer program which searches out along rays extending from that cell. The user can specify the range of angle, distance, and density of coverage which are desired for any search. The program records the user-specified analyses as it processes the searches from each origin cell in turn. The model produces in a mapped format the pattern of development and landscape types recognizable from any set of view origins. It also produces (optional) tabular output for each view origin in which each 45^0 octant and radial distance zone is described in terms of the distribution of types within view.

In its evaluative output, the model identifies the visual preferences of the seen cells and the visual quality of the views from any origin or set of origins. The model recognizes that places are perceived and evaluated differently as a function of their type and distance from the observer. Therefore, the model describes and evaluates the land use and landscape types in more aggregated groups as distance increases from the origin cell. Each of the 267 land use and landscape types has been assigned preference ratings as a function of its distance to a view origin. The ratings are based upon the literature (Frederick and Steinitz 1974) with extensive photographic-interview field studies as a verification of the preference evaluations. A five-level rating system is used: most positive, positive, neutral, negative, and most negative. The model is organized around three user-defined distance zones: near (0-200 m.), middle (200-800 m.) and far (800-2600 m.). Thus, each type can have up to three preference ratings. In general, as distance increases, the ratings tend away from the extremely positive or negative groups and towards the neutral. Figure 3 illustrates selected near-view preferences, indicating in effect the visual preference of a cell for a viewer located in it.

What is the quality of the views from the origins within the North River Viewshed? The evaluation of the quality of the view from a cell involves the entire capabilities of the visual model discussed to this point. We have concluded from the literature and our own interviews that visual preference evaluations tend to neutralize as the viewing distance increases. The rate of neutralization tends to be a function of the visual dominance of the structure of the landscape type. Very dominant elements, such as large industrial buildings, tend toward a neutral preference more slowly as the viewing distance becomes greater. A second conclusion, at which we arrived from the literature and our interview-based observations, was that visual diversity, or the number of different visual elements in a view, acts as a magnifier of visual preference. Views tend to have higher visual quality ratings if they have a greater diversity of positively preferred types and they tend to get worse ratings if they have a greater diversity of negatively preferred elements. Based on the hypothesis that visual quality is a function of the land use and landscape types being seen, their preference ratings, their distance from the viewing origin, and their positive and negative diversity, the most successful explanation of the photograph-based interview evaluations of visual quality is the formulation:

Figure 3 -- Selected Preference Ratings



Using a scale for preference of most positive = +2, positive = +1, neutral = 0, negative = -1, and most negative = -2:

View Quality = for the near view zone,

(total positive preference score) x (number of positive and neutral types seen)

+

(total negative preference score) x (number of negative types seen)

+

for the middle view zone, *(the above calculations) ÷ 3*

+

for the far view zone, *(the above calculation) ÷ 9*

Mid and far view distance zone scores are divided by three and nine respectively to correct for increasingly greater numbers of cells in the distance zones as defined for this study.

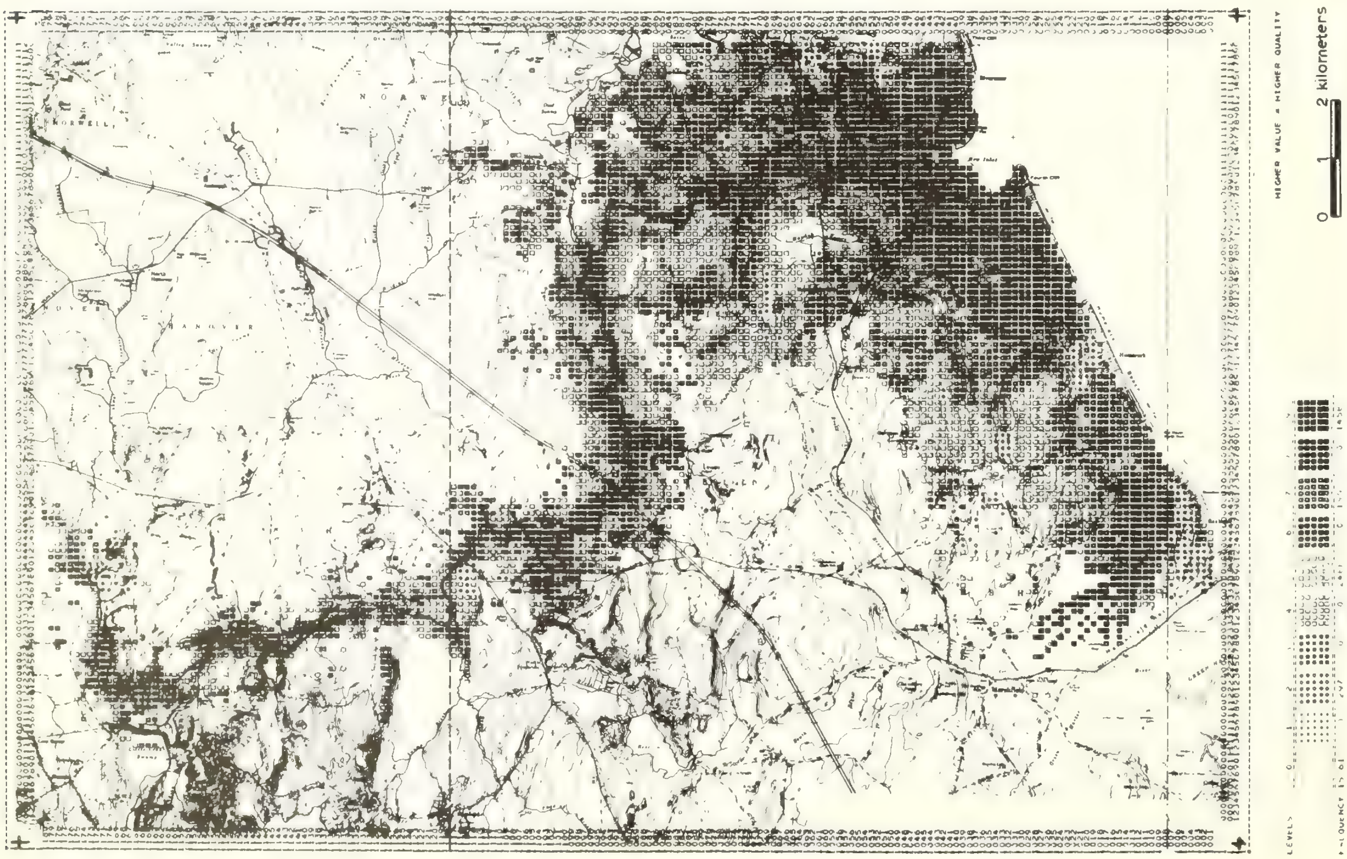
The search procedure was applied to all cells in the study area and view quality scores were calculated. Even though a strict rank ordering can be produced, the view quality scores were divided into five ranges of most positive, positive, neutral, negative, and most negative, which correspond to the more aggregated levels in which the interviewees tended to group photos. Furthermore, while the process of searching and evaluating is organized by forty-five degree view octants, and it is possible to compare the "best view" octant or quadrant from a point with its "worst view" evaluations, only average results are reported herein. Figure 4 shows the existing visual quality of the views from the origins within the North River Viewshed.

3.0 THE ALTERNATIVE REGULATORY APPROACHES AND THE SCENARIOS

The implementation scenarios which have been simulated in this study combine several regulatory approaches proposed by MASS D.E.M. and the various public committees associated with the North River Pilot Project and some suggested by the research team. They include proposed soil erosion controls and tree cutting limitations, proposed underground utilities, and proposed zoning changes in the corridor and viewshed. These implementation approaches are described in Draft: Scenic River Protective Order Under Mass. G.L. c21, s. 17B, for the North River, MASS D.E.M., 1978, and are selectively applied to the river corridor and viewshed.

The scenic corridor of the North River has been defined in the Scenic and Recreational Rivers Act, G.L. Ch. 21, Sec. 17B as being "...rivers and streams of the commonwealth or portions thereof, and such contiguous land not to exceed one hundred yards on either side of the natural bank of such river as the commissioner reasonably deems it necessary to

Figure 4--Visual Quality, River View Area 1975



protect by such order." The term "river" is interpreted as being defined by the natural bank, as shown by the mean annual high water line which in tidal portions is the same as the mean annual high tide. It is also the landward edge of the salt water vegetation. This zone comes under the potential jurisdiction of the regulatory process. The viewshed lies outside the corridor and has been defined by MASS D.E.M. on the basis of a field survey taken from the North River at mid-tide in November 1977.

Tree-cutting controls: Draft Protective Order, Sec. 8C2, calls for the maximum preservation of existing vegetation in the corridor. It calls for various non-cleared setbacks and is intended to maintain treed "screens" between new development and the North River. Erosion controls: Draft Protective Order, Secs. 8C1E and 9E, propose controls which will minimize soil erosion during the construction process. Underground utilities: Draft Protective Order, Sec. 5G, proposes that wire utilities be placed underground. When applied, these three regulatory approaches result in additional costs which are calculated for each housing type and location and which then influence the housing allocation model. They are known as the "housing costs." Zoning changes: Several zoning changes within the corridor and the viewshed are proposed and tested in the various scenarios. These include changing all zoning in the corridor to 1 unit/½ acre, 1 unit/1 acre and 1 unit/2 acre minimum residential density, and changing all zoning in the viewshed to 1 unit/½ acre and 1 unit/1 acre minimum residential density. These new constraints are entered in their applicable locations into the zoning matrices which limit the availability of sites for the housing types. Conservation and recreation purchases: Scenario #5 tests the effects of a major and immediate public open space allocation program including a new regional park, state conservation land, town parks and town conservation land. The locations are entered into the data base prior to the housing model, and thus become a constraint by being unavailable for development.

3.1 The Alternative Regulatory Scenarios

When taken in various combinations, as specified by MASS D.E.M. and shown in Table 1, there are eleven scenarios which have been tested in a ten-year simulation, with four of these having been simulated for twenty years as well. The scenario numbers refer to specific computer simulations and are adopted for the convenience of the research team. Their presentation follows an order reflecting the potential effectiveness of the regulations being simulated.

Table 1--The alternative policy scenarios.

		Alternative Policy Scenarios											
		simulated for:	scenario number										
	Alternative Regulatory Approaches	10 yrs	1	2	3	4	5	7	8	9	10	11	13
		20 yrs	1a	2a	3a								13a
Corridor	2-acre Zoning										X		X
	1-Acre Zoning		X		X		X	X	X				
	1/2-Acre Zoning					X						X	
	Tree Cutting				X	X	X	X	X	X	X		X
	Erosion Control				X	X	X	X	X	X	X		X
	Underground Utilities				X	X	X	X	X	X	X		X
	Conservation/Recreation Purchase						X						
	Development Ban			X									
Viewshed	1-Acre Zoning		X	X	X	X	X		X	X	X	X	X
	1/2 Acre Zoning							X					
	Tree Cutting								X				X
	Erosion Control								X				X
	Underground Utilities								X				X
	Conservation/Recreation Purchase						X						

For example, Scenario 1 is based on the assumption that there will be no changes in the existing constraints to development and that there will be no new regulatory measures associated with any implementation program of the MASS Scenic and Recreational Rivers Act. In effect, Scenario 1 presents a trend projection which predicts future regional development on the basis of current policies. The results of this trend projection are the base against which the impacts of alternative policies and regulatory practices associated with the Scenic Rivers Act can be measured. Among the existing development constraints simulated in Scenario 1 are the current one acre zoning pattern, septic tank regulations, and building cost constraints associated with wetlands, exposed bedrock, difficult soil conditions, etc. Scenario 1 has been simulated for a ten-year demand for new housing. Scenario 1a follows the same assumptions and has been extended to twenty years.

For the benefit of reader sanity, we present only the new development results in map format for the "Full Draft Protective Order" (scenario 3 and 3a). A comparative evaluation of all the scenarios will be made in the final section of the paper.

Scenario 3 represents the proposal by the Mass. Department of Environmental Management.

It is also interpreted as being the maximum extent of the legislative authority to implement the Mass. Scenic and Recreational Rivers Act. It proposes to change all zoning in the corridor to one unit per acre minimum residential density and it proposes to add housing cost constraints to represent the minimum cutting of trees, erosion controlling construction practices, and the provision of underground utilities. No new controls are proposed for the viewshed. Scenario 3 has been simulated for a ten year demand period. Scenario 3a operates on the same assumptions and it has been simulated for a twenty year period. Figure 5 shows the 1975 housing pattern by type in the DEM corridor and viewshed. Figure 6 shows the total housing pattern in 1995, including the additional development simulated in Scenario 3 and 3a. Thus, Figures 5 and 6 illustrate the ends of one growth sequence based upon one regulatory scenario.

These figures should not be misinterpreted. They do not predict that the areas which are simulated as being developed will in fact have their current ownership transferred and become developed. The basic assumption of the Housing Model is that the rate-of-return in the long run dominates the decision to develop housing and that the owner typically will be prepared to sell "when the price is right." The simulations are a reflection of development pressures and not of actual development decisions.

4.0 COMPARISON OF THE SIMULATION FINDINGS

When comparing the simulation results, two aspects of the regional context must be kept in mind. First, the D.E.M. corridor area contains a very small percentage of the developable land in the Boston Region's South Shore. However, it represents almost half of the South Shore's area whose views would be evaluated as having most positive visual quality. Thus, a small percentage of the region's growth, if located in the North River corridor, can have a major impact not only on the river itself but also on the image of the region's principal scenic asset.

Second, the D.E.M. corridor has a limited "capacity" for development. Even though most people have a sense of this zone as being "natural" and "scenic," its land area is already almost 40% controlled by urban land uses. If its entire capacity is developed, the D.E.M. corridor could be 70% "built up." The remaining land is either unsuitable for non-sewered development or already in conservation and recreation land uses. Thus the implementation of the Scenic and Recreational Rivers Act is considering a river whose land edges have a potential of being between 40% and 70% developed. Given the large regional demand for new housing, the key issues will be the rate that development fills the area to capacity, its location, the types of housing that are located, and its population consequences. These in turn will profoundly affect the visual character and quality of the river corridor and viewshed.

4.1 Changes in Development

Table 2 shows the land area of the D.E.M. corridor whose development has been forecast by the Housing Model in each scenario and the percent of the developable land capacity of the corridor which has been built upon. The range is considerable. Table 3 also shows the number of new housing units and the new population which have located in the D.E.M. corridor in each scenario. Two important conclusions can be drawn from this table. First, it is clear that the different scenarios produce a wide range of land development and new population growth in the D.E.M. corridor. Second, that the development capacity of this zone will be completely filled within twenty years unless stronger measures than currently exist or that are proposed in the Draft Protective Order are taken. Furthermore, if the existing zoning for residential densities were to be relaxed as in Scenario 12, the development capacity might be reached within ten years

Table 2--Land area developed in each scenario and new residential units and new population in each scenario.

Scenario	Ha. Developed in Corridor	% of 212 ha. Developable "Capacity" in Corridor[1]	New Units in Corridor	New Population in Corridor
1	163	77	348	1218
12	234	100+	818	2863
4	231	100+	924	3234
3	97	46	194	679
5	47	22	92	322
8	97	46	194	679
7	97	46	194	679
9	91	43	40	840
10	0	0	0	0
13	0	0	0	0
2	0	0	0	0
1a	196	92	498	1743
3a	222	100+	442	1547
13a	3	0	3	11
2a	0	0	0	0

Scenario 1 C,V: Trend Projection, no changes 10/20
Scenario12 C: Zoning 1/2 Acre /10
Scenario 4 C: Zoning 1/2 Acre, Housing Costs /10
Scenario 3 C: Zoning 1 Acre, Housing Costs, "full order" 10/20
Scenario 5 C: Zoning 1 Acre, Housing Costs, C,V: Cons.,-Rec. Purchase /
Scenario 8 C: Zoning 1 Acre, Housing Costs, V: Housing Costs /10
Scenario 7 C: Zoning 1 Acre, Housing Costs, V: Zoning 1/2 Acre /10
Scenario 9 C: Housing Costs /10
Scenario13 C: Zoning 2 Acre, Housing Costs
V: Zoning 1 Acre, Housing Costs 10/20
Scenario 2 C: No Development 10/20

Figure 5--Existing Housing Mass. D.E.M. Corridor and Viewshed 1975

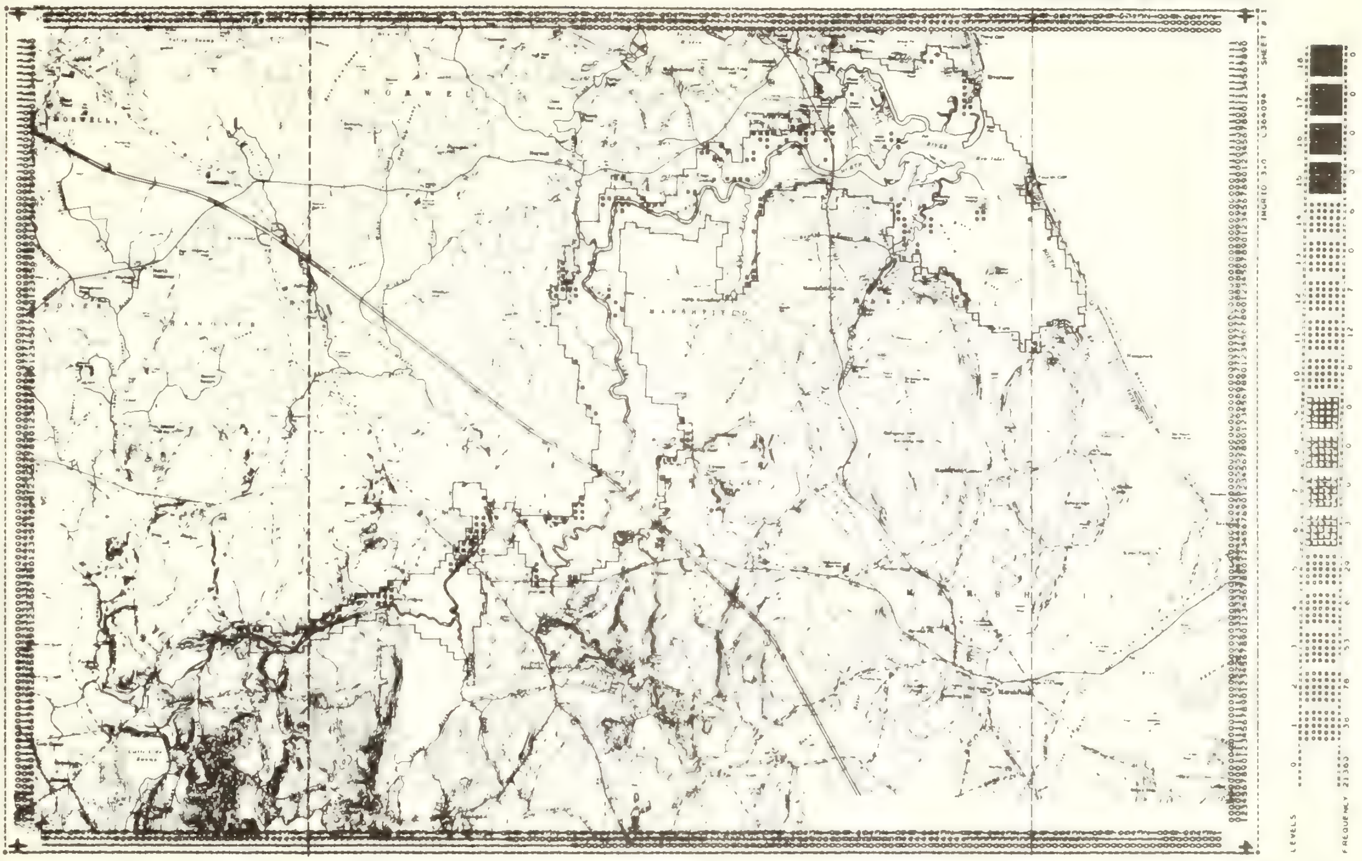
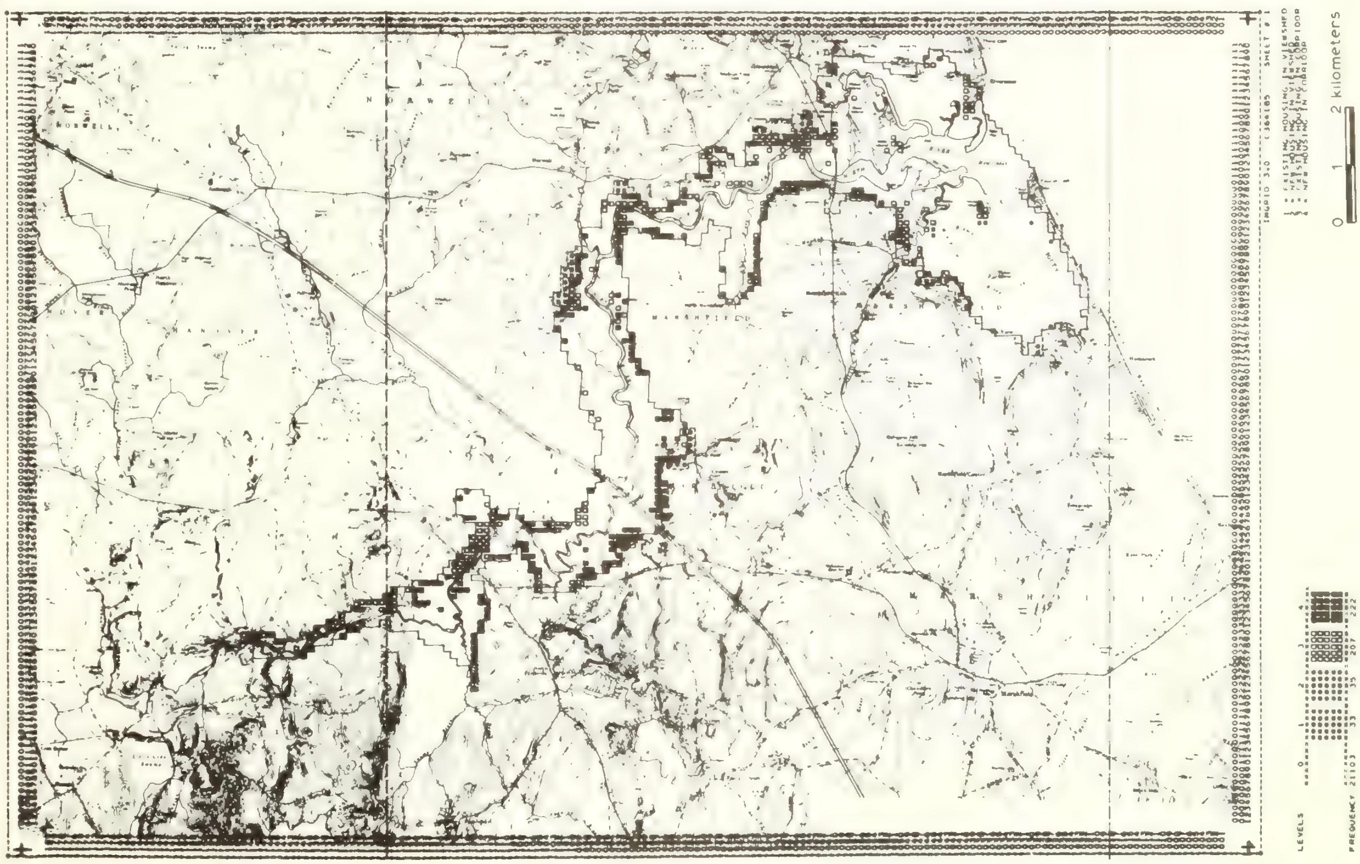

0 = NOT IN CORRIDOR OR VIEWSHED
1-5 = SINGLE FAMILY HOUSING IN CORRIDOR
6-9 = MULTI-FAMILY HOUSING IN CORRIDOR
10-14 = SINGLE FAMILY HOUSING IN VIEWSHED
15-19 = MULTI-FAMILY HOUSING IN VIEWSHED
NORWELL
HANOVER
MARSHFIELD
IMGRID 3.0
SHEET 1
LEVELS
FREQUENCY

Figure 6--Scenario 3a, "Full Order" Total Area of Housing Development 1995


1 = EXISTING HOUSING IN VIEWSHED
2 = NEW HOUSING IN VIEWSHED
3 = EXISTING HOUSING IN CORRIDOR
4 = NEW HOUSING IN CORRIDOR
IMGRID 3.0
SHEET 1
0
1
2 kilometers
NORWELL
HANOVER
MARSHFIELD
LEVELS
FREQUENCY

In analyzing the results displayed in the table, we can group the various scenarios into three general types. The first are those which relax the current controls (scenarios 4 and 12). These scenarios have provided an increased area for one unit per half-acre housing and since in addition there is a very limited supply of available land for this type, all potentially developable sites are built upon in 10 years. Indeed the demand is so strong in some parts of the study region that land which under normal conditions would be considered undevelopable has been made so through the additional costs of site preparation which are provided for within the Housing Model.

The second group of scenarios can be characterized as those which generally follow current patterns. This is the group whose results are typified by both the trend and the "full order" (scenarios 1 and 3). Several of the other scenarios which have similar results share with these the characteristics of following the current one-acre zoning patterns, but also employ the added housing cost constraints. These generally result in filling approximately half of the development capacity within the ten-year period. Given the overall rate of population growth in the Boston Region's South Shore, it can be expected that these scenarios would virtually fill the development capacity in about twenty years and this has been the result of the extension of these scenarios to that period (scenarios 1a and 3a).

The third group of scenarios takes more radical regulatory actions than those proposed by the "full order." Scenario #5 proposed the purchase of a substantial percentage of the land which is developable but which also is exceptionally attractive for recreational activities. The net effect of this was to remove the majority of the developable land from the market, thus limiting the amount of development. The other scenarios which are very effective in limiting development are those which propose to reduce the allowable residential density to a minimum of one unit per two acres (scenarios 10 and 13). From the analysis of regional housing demands it is clear that there is a relatively small demand for very large lot housing. It is obviously very expensive and it is not the housing type with the highest rate of return for developers. Furthermore, when the supply of available land and the rates for return are looked at regionally, there are many more profitable sites for this type available in other parts of the South Shore. The effect of the zoning change to lower densities, even when combined with the additional housing cost constraints, is not to prevent housing development. However, that is the effective result. They will not come to the North River until later, when the currently available and more preferable sites have been filled. These scenarios thus represent a delaying action, whose effect for the twenty-year period shows a substantially lesser amount of development than do any of the other scenarios.

Another effect which can be demonstrated from the results is that the imposition of added housing costs related to the construction performance standards tend to increase the residential densities which get constructed The additional costs cause several areas to shift from two-acre housing to one-acre. Apparently, there are economies of scale to developers in spreading these costs to purchasers.

The range of new population results is striking. Scenarios 12 and 4 produce approximately 3000 new residents within the ten-year period, during which their development capacity is filled. The trend and the "full order" fill the development capacity in about twenty years, with a new population growth of around 2000. However, in that same twenty-year period, the more radical regulatory approaches result in a new population growth of only about 200 new residents.

At this point we must caution against the simplistic conclusion that smaller growth in the corridor indicates that the more radical approaches might result in better fiscal impacts on the various towns. This may or may not be true. What must be kept in mind is that as the various regulatory approaches shift new development from or toward the D.E.M. corridor and viewshed, there are "chain reaction effects" in all of the other parts of the regional market. Thus, for example, shifting development away from the corridor might shift it to other parts of the same towns. The river corridor is neither a closed system in terms of its housing market nor in terms of any of its economic, environmental, or social systems.

4.2 The Comparative Effectiveness of the Regulatory Scenarios in Managing the Scenic Character of the North River

The visual impacts of the new development in the various scenarios can be analyzed both in terms of the effects of new housing in changing the physical appearance of land (its visual preference), as well as by the effect of new housing in altering the visual quality of the views from the various parts of the corridor and viewshed. Of particular importance are the changed visual qualities of the views from the North River itself. Two measures have been chosen as being desirable: (1) a smaller negative change in the visual preference evaluations of the views of the land in the corridor, and (2) a smaller negative change in the visual quality evaluations of the view from the land in the corridor.

Table 3--Existing visual preference of, and visual quality from, hectares changed by new development. The comparative effectiveness of the regulatory scenarios.

D.E.M. Corridor						
Scenario	# of ha. Developed	Preference		Quality		Summary Rank
		Total	Average	Total	Average	
1975 Total	1905	2297	1.2	2116	1.1	
1985						
1	163	160	1.0	63	0.4	9
12	234	209	0.9	107	0.5	11
4	231	210	0.9	105	0.5	11
3	97	103	1.1	34	0.4	5
5	47	33	0.7	38	0.8	4
8	97	103	1.1	34	0.4	5
7	97	103	1.1	34	0.4	5
9	91	94	1.0	32	0.4	8
10	0	0	-	0	-	1
13	0	0	-	0	-	1
2	0	0	-	0	-	1
1995						
1a	196	178	0.9	82	0.4	4
3a	222	205	0.9	99	0.4	4
13a	3	3	1.0	0	-	2
2a	0	0	-	0	-	1

Key:
most positive = +2.0
positive = +1.0
neutral = 0.0
negative = -1.0
most negative = -2.0

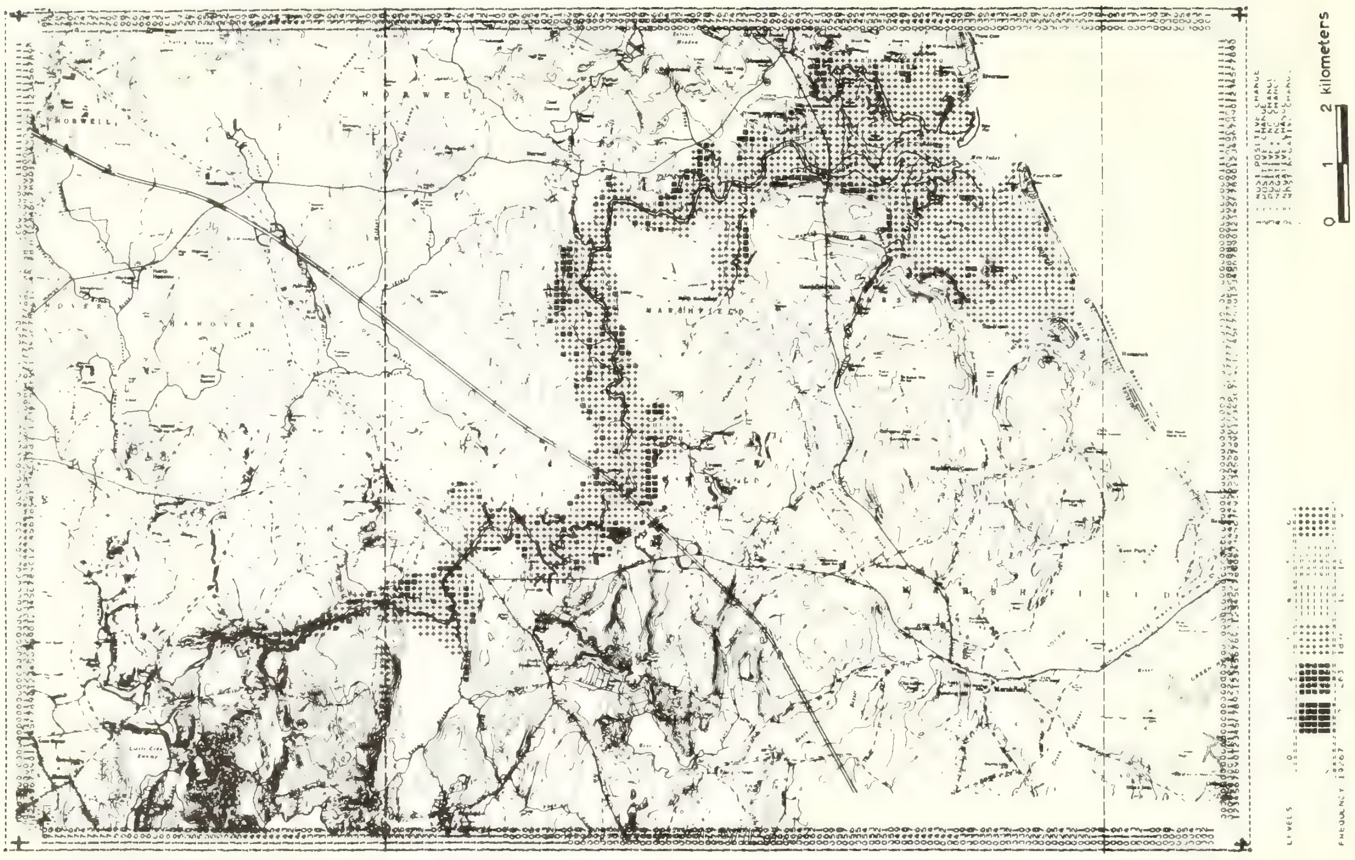
Table 3 shows the change in visual preference and visual quality. The values for both preference and quality shown on Table 3 have been calculated as the sum of the values for those cells which have been changed due to new development. The D.E.M. corridor currently has generally positive preference and visual quality evaluations. Its developable land is a mix of neutral (forest) and positively rated areas (open and agricultural land). In general the new development is being located in the predominantly forested portions of the corridor and the viewshed. The greatest negative impact on the existing visual character of the North River is caused in those scenarios which have allowed the more intensive half-acre housing and which as a result have had the maximum development (scenarios 4 and 12). The other scenarios which attempt new scenic regulations all have lesser impacts than does the current trend within the first ten-year period (scenario 1) and also within the twenty-year simulation (scenario 1a). However, with the exception of those scenarios which effectively limit development through prior purchase of land or two-acre zoning, the negative changes in visual preference and visual quality would still be substantial and would be perceived as such. In summary, it appears that the only two approaches which afford maximum visual protection for the D.E.M. corridor and viewshed (other than the confiscatory approach simulated in scenarios 2 and 2a) are the "down-zoning" of the corridor and viewshed as simulated in scenarios 10 and 13, and the prior purchase of conservation and recreation land simulated in scenario 5.

The current trend (scenarios 1 and 1a) would cause the river to be no longer a natural scenic river. Even the proposed "full-order" (scenarios 3 and 3a) would result in major visual changes for the worse. Without doubt the magnitude and location of these changes would be a function of the extent to which the proposed tree screening, erosion controls, and underground utility constraints could be effectively imposed and managed over time. We must keep in mind that the scenarios assume the adoption and the effective management of proposed regulations. Without both, the visual character of the North River will rapidly and seriously deteriorate.

What will be the longer-term visual impacts of the implementation of the Draft Protective Order? After simulating the residential growth in the D.E.M. corridor and viewshed according to the "full order" in scenarios 3 and 3a, the scope of the potential changes in visual character of the area becomes clearer. The large number of negative changes in the preference ratings of the views of hectares in the D.E.M. corridor and viewshed directly reflects the amount of new housing which changes the currently "positive" open and agricultural land and "neutral" forest to "negative" evaluated housing. There is no doubt that this visual preference evaluation reflects a current attitude of residents in the study area towards stereotypical new housing types. Furthermore, the challenge to produce excellent local site and building design can be possibly put and met. However, the likelihood is high that the overall impact will indeed be negative given the amount of housing which is projected, and the physical character of the housing typically built in the region.

The change in the visual quality of the views from hectares in the D.E.M. corridor and viewshed shown in Figure 7 relects a major conflict regarding "whose views?" The land in the corridor which is newly developed as housing generally improves its views. Trees are newly cut (even within the scope of the

Figure 7 -- Scenario 3a, "Full Order"
Changes in Visual Quality
1975-1995



draft regulations), and highly valued water and wetland views are opened from what was previously dense forest. These views are the private gain of the house-owner. The negative visual quality changes are all views from the river wetlands--the very conditions which the public enjoys and which the Massachusetts Scenic and Recreational Rivers Act is intended to protect. There is a tradeoff between the private gain in visual quality of the person who clear cuts to achieve a view of the river and the private and public loss of the people who then see his building from what otherwise was a most positively evaluated "natural" landscape. This is the essence of the problem, and underlines the central importance of enforcing regulations in the public interest.

It appears from the results of the scenarios that the various cost constraints which represent construction performance standards (erosion controls, underground utilities, and tree screening) will not be effective in reducing development. Neither do these constraints have a major impact on the location of new housing. It appears that the added costs can be absorbed by the consumer in a higher price of housing. If the proposed regulations can be rigorously enforced, they will result in new development which is in conformity to the performance standards and their intent. However, the major issue with regard to these construction performance regulations will be whether an implementation process can be organized which will in fact enforce the Draft Protective Order over the long term. If the Scenic and Recreational Act regulations are not managed or if they are ineffective, we can foresee the change of the North River from its current rural and relatively undeveloped character to a much more highly developed urban river within a 20-year period. It will then no longer be a "Scenic River."

POSTSCRIPT

This paper presents a summary of what was a much more complex and detailed study, particularly as related to the results associated with each scenario. These were presented in a report (Steinitz 1978) and in public presentation to various committees associated with the North River. The principal findings and arguments pertaining to the effectiveness of the regulatory scenarios were understood. However, the development-related scenic management decisions taken by the local towns and subsequently reflected in the North River Management Plan (Massachusetts Department of Environmental Management 1979) were based upon only the implementation of construction-related controls rather than zoning or land purchase changes. To quote from the Plan, "These results were presented to the advisory committee, but the local consensus was that they wanted to maintain the one-acre zoning and were willing to accommodate the increase in development to saturation along the river."

Malum est consilium, quod mutari non potest.

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Any opinions, findings, conclusions or recommendations expressed herein are those of the author and do not necessarily reflect the views of the National Science Foundation, the University of Washington, The Department of Environmental Management, The Commonwealth of Massachusetts, or the Graduate School of Design, Harvard University.

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Combining Computer and Manual Overlays—Willamette River Greenway Study[1]

Asa Hanamoto and Lucille Biesbroeck[2]

Abstract: We will present a method of combining computer mapping with manual overlays. An example of its use is the Willamette River Greenway Study produced for the State of Oregon Department of Transportation in 1974. This one year planning study included analysis of data relevant to a 286-mile river system. The product is a "wise use" plan which conserves the basic character of the land. The process offers a complete analysis and overview for sensitivity of land to human use. Visual qualities of the landscape as well as environmental and cultural resources were recorded and displayed in various combinations for analysis. Opportunities for specific use and management guidelines were also based on the integrity of the resource.

INTRODUCTION

There have always been a need and a desire for humans to adjust to their physical environment or to modify it in order to meet requirements of food, shelter, and setting. Today, economic and technological sophistication enables greater control for the physical environment than ever before.

The role of the landscape architect/land planner lies in contributing to solutions for both social and environmental problems. These professionals offer expertise as designers, planners, and communicators who are concerned with both visual quality and form of the environment and the interrelationship of people and the land. Because of this concern, the landscape architect/land planner may work at any scale. The work includes design of small site projects with their related amenities and the orchestration of regional, national or international projects which attempt to develop policy for qualitative use of the land.

The environment is the visual, physical, chemical, biological and social setting in which people work, live and play. Consequently, a plan is usually devised for the relationships between any conflicting demands and desires in light of aesthetic, natural and social constraints.

Few study areas or sites are totally independent. External dependencies and impacts exist in most areas to a greater or lesser degree. These dependencies should be factored into an environmental evaluation.

Existing long-range planning efforts are reflective of the awareness that visual and land use management of the landscape is necessary. Such planning should not only be near term, but have a future legacy as well. Agencies at all levels utilize criteria established by master plans to make day-to-day decisions. New legislation has been passed, new enforcement agencies formed and old ones reorganized that have roles in land use planning. New participants in the planning process include citizen activists and planning teams with expertise in the two major aspects of all planning issues, namely the technical-scientific and the political-social.

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[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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The landscape architect/land planner has emerged as having the expertise to lead the multidisciplinary professionals involved in land use planning. This leadership includes evaluating and translating various points of view into a viable management plan that integrates those facets of visual and land use protection, enhancement and design into a quality end product. The exchange and processing of information are integral to the end results.

Methodologies are conceived as a means to deal with the processing of data for application of specific land use.

This paper presents one approach to dealing with a planning problem. The method is based on the combining of computer mapping with manual overlays. The process offers a complete analysis and overview for determining sensitivity of land to human use. The text will follow the planning process sequence and the Willamette River Greenway Study will be utilized to illustrate examples of the methodology. The objective of that study was to develop a comprehensive development/management plan for the River. The aims were to: a) protect and preserve the natural scenic qualities of lands, b) acquire and develop lands for recreation and c) preserve and restore historical sites, structures, facilities and objects on lands along the Willamette River in Oregon between the Columbia River and Dexter and Cottage Grove Reservoirs, including all channels, a total distance of 286 miles. The resultant document is a large scale working plan for use by all local and State agencies. Revising and updating may be done in segments using county boundaries as divisions.

A plan is a way for people to express their desire for the future. It must take into account the intent of legislation, the desires of the citizens and the visual, physical and cultural characteristics of the study area.

The Willamette River area involves visual, natural, recreational, urban and agricultural activities. The pressure for development necessitated some plan which would preserve areas of natural beauty, areas of historical or scenic value as well as agricultural lands. The State of Oregon was the only agency which had jurisdiction over the entire River and had the authority to coordinate land uses along its entire frontage. With the passage of legislation in 1973, the State took the role of setting forth basic parameters for the use of the River and its adjacent lands.

The Greenway Law, as ORS 390.-368 has come to be known, provided a new statement of the elements to be included in the Willamette River Greenway. It required that a plan for the development and management of the Greenway be prepared and submitted to the Land Conservation and Development Commission (LCDC) for approval. The Law laid out some precise constraints on Greenway planning and implementation. These included a definition of the maximum and minimum area to be included in the Greenway and a prohibition of State and county use of condemnation procedures for acquisition of existing agricultural land in establishing the Greenway. It prevented public use of scenic easements and prescribed five areas for State park acquisition. It also made provisions for financial assistance to local governments to implement portions of the Greenway Plan within their jurisdiction.

Directions for the plan development and implementation were clearly defined in the Law. However, additional refinement was necessary such as identifying existing land uses, and determining the role of urban areas and non-agricultural lands in the Greenway. Also, it was necessary to determine: 1) visual attractiveness, 2) natural, and 3) recreational qualities of the River and its adjacent lands and to what degree these qualities required protection and preservation. The Law laid out many of the Greenway definitions and parameters, but it was not all inclusive. It served as a foundation upon which the plan was constructed along with local governments and citizen policy input.

The Greenway planning process encompassed six major elements:

- Inventory and Visual Reconnaissance
- Information Process
- Public Involvement
- Analysis
- Design
- Implementation

PLANNING PROCESS

Inventory and Visual Reconnaissance

Data were compiled to be applied to planning questions. The procedures of collecting up-to-date information were diverse among agencies and individuals. Sources of information included existing reports and field visits. Pertinent information was pooled into a reservoir or data bank. It included maps, photographs, texts, and other fact-bearing material.

In the delineation and description of the Willamette Greenway and its use potential, the planning team identified, collected, and analyzed a well-rounded information inventory concerning the Willamette River and its environs.

The resultant library consisted of pertinent Federal, State, county and city plans, texts and proposals. Analysis of this body of information served to determine data gaps and the need to generate additional materials.

Subsequent visual reconnaissance included familiarization with the site as well as collection and review of additional plans, reports, studies, and legislation. The entire study corridor was flown several times; first as an overview and subsequently for increasingly detailed looks at the visual value of specific areas. Varied land uses were observed and catalogued with an eye to their relationship with each other and with the River. Study of aerial photographs and more detailed site analysis was followed with a reconnaissance by boat to explore the River. Special attention was given to evaluating the varying characteristics of the River and their scenic qualities. Focus was also given to noting the potential problems and opportunities involved with providing public use of a sensitive resource while respecting existing land uses along the River. These observations were refined with a land reconnaissance by automobile along roads with potential for scenic river-related drives and by walking through typical farms and wild portions of the riverbank.

The visual site reconnaissance and review of inventory material were part of the macroscale analysis of the study. The analysis determined that: the recreation potential along the 286-mile river system is varied and extensive. The 1973 Greenway Legislation (ORS 390. 310.-386) requires regulation of existing land uses such as gravel quarrying along the River, and integrating of new uses with existing farmland. In addition, the sensitivity of the River's resource and adjacent environment limits human use. Thus, the requirement of the Law and the sensitivity will only allow selected public use of the River and its banks.

INFORMATION PROCESS

The inventory effort required a management framework to determine data requirement, standards and documentation of data flow.

Two alternative methods were available for the storage, retrieval, updating, and display of inventory material. They are computer and manual, or both. To determine the desirability of computer-based or manual-based information, the types of data and their application had to be identified. Typically, data fell into two basic categories: natural and cultural. Applications of the data were numerous. They included area-wide location decisions derived from geographically displayed data such as soils, vegetation, and topography. They included policy decisions derivable from citizen input. They also included design decisions related to projection of visual attractiveness, recreation or other land use.

Decisions were made on information as complete as possible using commonly accepted criteria and in coordination with participating agencies and citizens. The choices used to facilitate planning were varied. The feasibility of any system or approach was determined by raising and answering the following questions: who will implement or administer the plan decisions; what will the plan do; where will it be used; and how much will it cost?

Some data could be encoded for computer manipulation while other data could not. Manual techniques include writing, listing, drawing, rendering, and photographing. Their retrieval was via an index system from a library, flat file, photo file, or other filing systems. Computer storage information was a mechanical/electronic process. Thus, resource inventory material could be comprised of four different types of information: computerized natural data, non-computerized (complementary) natural data, computerized cultural data, and non-computerized (complementary) cultural data.

The Willamette strategy was developed to facilitate comprehension of the potential intensity of human use throughout the Greenway. The analytical models needed were resolved and the types of data required to produce these models were defined. The process of coordinating existing data and filling data gaps could then proceed through the actual production of each analysis model and the delineation of a corridor of sensitivity and potential Greenway use.

Data evaluation efforts were focused into two groupings: computerized and non-computerized. The first group which was computerized, consisted of geomorphology, biotic processes, soils, natural vegetation, topographic slope and floodplain. These data are representative of natural factors related to the River's environs. The second group concentrated on visual quality, history, archeology, land use, aggregate deposits, water quality and hydraulics, recreation demand, and citizen participation. These additional manual complementary factors established a broader basis upon which to weigh, evaluate and influence interrelationships.

Establishing visual and physical form determinants and potential impact categories was a significant task which had to be accomplished in order to perform a complete analysis.

Consideration of future land uses along the River required an understanding of the multi-dimensional potential use of the Greenway as defined by ORS 390.310.-368. A scope and vocabulary were established for a working definition of recreational open space, conservation and preservation areas. An existing land use and zoning map was prepared. Ecological constraints, i.e., areas of river flooding, course changes, water use, and biotic communities were reviewed. A list of possible issues involved in implementing a resource use system included land ownership, land use demand, and management. Regional and sub-area needs were considered and tabulated from State data. Parameters for elements of the Greenway were identified, i.e., natural elements, visual open space, conservation areas, active recreation areas, access points, preservation areas, agricultural lands, resource extraction, and urban elements.

Preparation of Base Grid Map

The choice of base map, scale and reference system varied from agency to agency. Data collected from many agencies was at many scales on many diverse base maps, or in other forms. All geographically referenced data had to be interpreted onto one common base map format. A common format was useful not only to the planner in making process decisions, but was necessary for ongoing administration of the project area, workshop presentations, and evaluation of the final plan.

A commonly acceptable scale for the Willamette Greenway project had to be one which covered the entire study corridor in a reasonable economy of space. It also had to be large enough to record adequate detail and allow fluent transmittal of plan design. The determining of the map scale then went hand-in-hand with refining the level of the study.

Map Scale--Following consultation with local and State agencies, it was decided that 1 inch equaling 2,000 feet was a suitable working scale. A composite of 7-1/2 minute quadrangle U.S.G.S. maps was made. The 286-mile length of River study area was then divided into regions. Each region represented one of the four Councils of Governments (COG's) within the study area. This resulted in two maps per COG's, or a total of eight base maps. All subsequent recording of information was thus developed on a coordinated data mapping system.

Grid--The U.S. Rectangular Land System was selected for the study, though the Universal Transverse Mercator (UTM) and Lambert Grid were also considered. The Willamette Stone is the marking point for the Willamette Meridian which is the point of origin for all public land surveys. The meridian also is located on the U.S.G.S. maps. It became the starting point for the study's 1-mile grid.

Cell Size--A grid overlay was prepared for the encoding of information. The grid or cell size is a 1/8 mile square, 660 feet by 660 feet, or approximately 10 acres. The dimensions, although relatively large, still made the cell fairly sensitive to variables.

Study Corridor--A study corridor was defined by use of aerial photographs and topographic maps. The aim was to include the River, adjacent public and private lands, channels, water bodies, and vegetation within the influence of the River.

Wherever possible, the corridor was extended to a natural break in the River's influence such as highway, floodplain, bench line, or topographic features. The boundary in complex urban areas was limited to 1/4 mile. This zone was assumed to be most directly influenced by the River, and the design and study efforts were concentrated in this corridor.

Ultimately, the study corridor encompassed some 25,000 10-acre cell units. The average width was approximately 1 mile on each side of the River. Each of the data collection categories covered the entire study corridor.

Obtain and Display Physical Data

The sufficiency of existing data was evaluated and supplemented as necessary. Data was placed into categories typically based on standard taxonomy. For example, study factors included: 1) existing land uses, i.e., urban, agricultural and recreation, 2) man-made or cultural factors such as ownership, jurisdiction, circulation and transportation, archeological and historical, and 3) land characteristics, i.e., landform, soil, vegetation, hydrology, minerals and aggregate, and wildlife habitats.

The data resource maps were prepared at a common scale. All physical data were mapped at the standard format scale of one inch equaling 2,000 feet. Some data was subsequently computerized for future indexing and expedient manipulation to create analysis model maps. Other categories were prepared as manual overlay entries. Additional non-computerized (complementary) data included concepts and policies. The data bank provided a complete reservoir from which a logical case for a Greenway Plan proceeded through analysis and design.

Data Interpretation

Data were analyzed to reveal constraints and opportunities, and to formulate predictions. Once data had been stored in a computer, an overlay process to develop comprehensive information for planning was begun. Two types of overlays were possible. The first type involved overlaying or combining of several data maps to determine "what happens" at any given location. The second type allowed for the weighing, or the considering of one of the data maps to be more important than the others. Whereas manual overlay might have been limited to three overlays, the computer overlayed as many as twenty or more maps simultaneously. This allowed the planner to study the effect of different weights.

The most common application of the overlay capability is suitability or constraint mapping. This method was used for the Willamette Study. Three computer models, or analysis maps, were generated with an assigned combination of encoded environmental factors.

The three model maps were entitled, "Sensitivity to Human Use," "Agricultural Suitability," and "Opportunities for Use Intensity" (fig. 1). Together, these maps served as a productive tool in abstracting information or orienting planning decisions to the interrelationships of various components of the River's environment.

Manual Data Overlay

To sharpen further the perspective of man's relationship to the River, additional data were manually recorded. Data subjects included visual quality, history, archeology, land use, public ownership, aggregate deposits, water quality and hydraulics, and citizen participation. The supplementary data were processed in a variety of forms from verbal description to pictorial and factual elements, or zone locations on manual overlay maps.

PUBLIC INVOLVEMENT

The value of citizen participation lay not so much in the generation of new ideas, but in the tempering and clarifying of needs and concepts, and in the generating of public support. The understanding and the support of concepts by participants were significant contributions in the approval and implementation stages of the project.

Exposure by the media was enhanced through workshops. While the media coverage was not always favorable, the issues raised were addressed as part of the public forum.

The problems created for the planner were: 1) how to get citizens involved in a meaningful way so they could understand how the plan came about and 2) how to display the information that was used to make planning decisions in a manner that everyone can understand.

A defined format and well-defined issues for citizen response were essential to facilitate consistency in citizen input. Participants aided in establishing planning values and importance ratios for the data used for non-computerized (complementary) or computer overlay. At the same time, citizens had the reinforcement of learning how the process works through having participated.

For a project of the magnitude and importance of the Willamette River Greenway, public involvement and public information were crucial. About seventy percent of the State's population lives in the Willamette Valley, and the great majority of these live within ten miles of the River. Throughout the project, there was involvement with citizen, staff, and local government participation.

Four types of public meetings were held in each of the four districts or Councils of Governments (COG's): 1) a public forum to learn relevant issues and citizen's attitudes toward the Greenway, 2) a one-day conference to develop policies for which a study guide was prepared to stimulate discussion among participants, 3) numerous half-day staff conferences to receive technical input and brief city and county legislators, and 4) several one-day workshops to refine policies into goals and guidelines. After the conferences, the citizen's recommendations were incorporated into a single set of goals and guidelines for the plan. Adoption of these required all local planning jurisdiction within the Willamette Greenway to adhere to consistent quality of land use regulation.

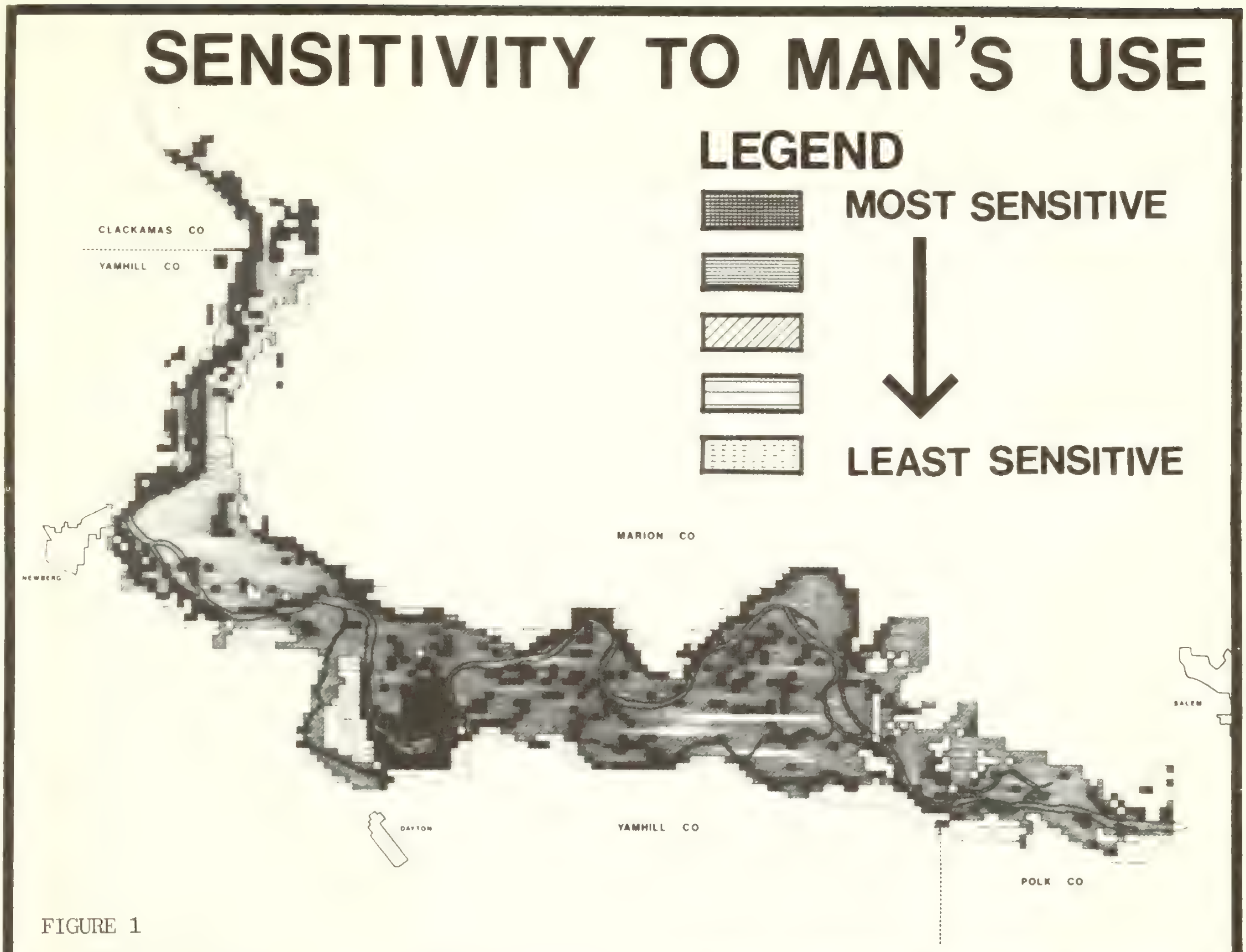

FIGURE 1

Geomorphology, soils, floodplain, natural vegetation, biotic process and agricultural suitability were inputted; the highest numerical importance of a cell determined the mapping category. The weighting was directed to take into account potential use of land and sensitive or endangered qualities of land, wildlife and vegetation along with pointing out non-conflicting best agricultural land.

The model map appeared in a breakdown of six levels of use categories: preservation, representing prescribed restricted use; three levels of conservation (1, 2 and 3) prescribing wise use with a greater or lesser degree of restriction required depending upon the level; farm, indicating areas now in and proposed other lands for potential "best" agricultural use; and recreation, lands which will accept the most intensive use. The map shows that the majority of the Greenway falls into one of the three levels of conservation or the farm category. It should be noted that a use intensity designation does not necessarily reflect the present use of that land. An area given an intensity designation of conservation-2 does not imply that it is used as such; only that potential suitability for a conservation-2 level of use is indicated.

Analysis

The task of the planner was to find the optimum solution to a given problem. The procedure was to identify first all possible solutions, then those that were feasible, and finally, those that were optimum. Each solution identified was passed through evaluation filters. These filters are composed of a valid set of criteria.

The set was complete, well-defined, and approved by all parties involved in the decision-making process. Ideally, the evaluation criteria are identified prior to generating alternative plans. Since the design process can occur over an extended period of time, it was necessary for the planner to re-assess criteria. However, the same criteria applied to judge a plan was the same as the criteria used to design it. These criteria crystalized to form the rules of procedure that modified design decisions, management procedure, and maintenance of the plan.

To weigh the evaluation criteria, the planners had to think in terms of ratios of importance. Criteria weights (load factors) were used as multipliers in the analysis methodology. They represented a professional judgment backed by experience, intuition and technical know-how.

Subsequent to the visual survey of the entire Willamette River from the different perspectives of air, river and road, basic concepts were formulated. Combined with the citizen policy statement and manual complementary cultural data, a coarse filtering produced the first stage in the design process. This was a "Concept and Opportunities" map. This map was used as a working base for further review and refinement in establishing goals, guidelines, and overall plan formulation.

At another level, the computer data was geo-coded (data with geographical locations attached) and weighted, i.e., from hand drawn source maps, a mesh or grid was superimposed over each map and a data value assigned to each cell. This encoded information was then used to produce the computerized analysis models which illustrated both land sensitivity and opportunities for use of the River's environment.

DESIGN

Visual reconnaissance, technical input, such as projections of land use and development pressures and citizen policies, were integrated with the analysis. The sensitivity of the Willamette River system observed and heard about was confirmed by the computer models produced. These various inputs were combined to arrive at a preliminary Greenway Plan.

Candidate recreation areas and open space areas were flagged. The existing Greenway legislation, as well as citizen, staff, and governmental input, pointed the direction toward the development of the Greenway concept of a managed conservation corridor connecting sites critical, both to conserving the River and to providing river-related recreation. The result was the mapping of Greenway boundaries.

Specific Greenway element locations and use criteria were discussed, defined and charted in light of the analysis and concept of a conservation-oriented system. Critical areas of concern were described. Opportunities for access to the River by trail, bicycle and automobile were also recorded.

IMPLEMENTATION

The recommendations of a study were evaluated and brought to fruition through the combined effort of citizens, staff, and elected officials. Acquisition, development, management, and updating are part of that program of plan implementation. The program is made up of many potential components that should embody a well-balanced need/use system in harmony with the sensitivities of the natural landscape.

The vocabulary of the Greenway includes terms of land use categories (river, urban, farm and non-farm), use intensity terms (preservation, conservation (1, 2 and 3) and recreation), goals and guidelines (environmental conservation, access, recreation, land use and development, management, and citizen participation).

The land use and intensity of use categories are described as to human activity, purpose, intent, management and special uses. All public and private lands within the Greenway, whatever their present land use, were classified as to the intensity of use necessary to conserve the River's environment.

TRANSFERABILITY

The extent of transferability utilizing both manual and computer processes can be geared to any project with large quantities of data to be synthesized. Measured application of the plan has been citizen and government adoption of specific plan elements and State acquisition of recommended lands for park purposes

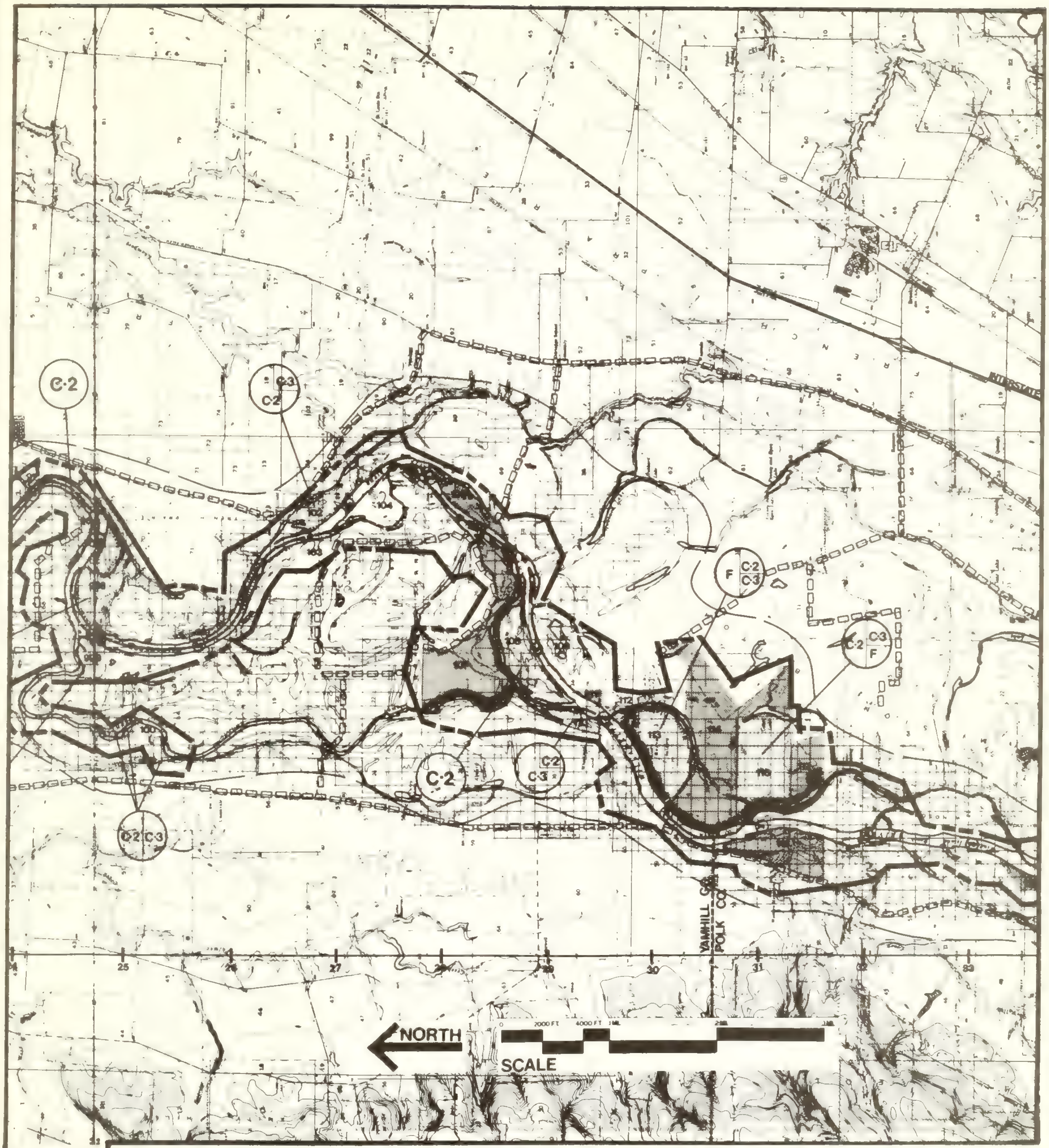

FIGURE 2

The product for the Willamette River Greenway is a conservation "wise use" plan. The plan map, combined with the analysis maps and background data, provided a tool for local planning bodies to analyze any site within the study corridor (fig. 2). They can evaluate the Greenway in terms of sensitivity to man's use, levels of use intensity, agricultural suitability, existing land use, and historical significance. This will prepare them for the more detailed studies they must perform in order to make decisions relating to land use proposals for specific sites in the Greenway corridor.

VIEWIT Uses on the Wild and Scenic Upper Missouri River[1]

Dwight K. Araki[2]

Abstract: This paper discusses a computer application approach to mapping the scenic boundaries on the Upper Missouri Wild and Scenic River. The approach taken in this effort was the computer program VIEWIT. VIEWIT, for seen area analysis, was developed over an eight-year period prior to 1968, by Elliot L. Amidon and Gary H. Elsner. This is the first attempt by the BLM to utilize this approach on a wild and scenic river. It began and was completed in the summer of 1977.

INTRODUCTION

In October of 1976, Congress recognized the historic significance and unique qualities of the Upper Missouri River by designating it a National Wild and Scenic River. The River is 149-miles long and is located in Montana between Fort Benton and the Fort Peck Reservoir. Lewis and Clark were the first explorers to document the scenic grandeur of the River. Congress required an overall management plan which provides a procedure to protect this natural resource.

One part of this management plan is the Visual Resource Management (VRM) of the River. By mapping and analyzing the areas that can be seen from the River, a management plan can be worked out which preserves the existing natural, primitive scenic quality along the River. This management plan will help to site future activities that must occur here, such as bridges, powerlines, or recreational buildings, to ensure minimum visual impacts on the scenic quality of the River.

The total area which can actually be seen from this 149-mile stretch of the River is called the viewshed of the River (Figure 1). This viewshed thus includes all the land which must be carefully managed to protect the scenic quality of the River.

The edge of the viewshed farthest from the River is called the scenic boundary. This scenic boundary on each side of the River is called the rim-to-rim-boundary of the River. The Wild and Scenic Rivers Act requires us to locate and map this rim-to-rim boundary since it serves as the legal bounds for all lands which will be protected. Thus, the scenic quality of the River can then be protected.

DESCRIPTION OF THE METHODOLOGY

Mapping the viewshed of the River and locating the rim-to-rim boundary are difficult to carry out by hand. The accuracy of this method is ensured only by a generalization of detail.

Rather than the strict eye/hand method of viewshed mapping, this project was assisted by the computer system VIEWIT (Travis et al. 1975). The VIEWIT system aids visual resource analysis by its ability to locate and map visible terrain from a single location or series of locations, called viewpoints. By using a series of 450 viewpoints along the length of the River, and by merging the viewshed of each viewpoint into one total viewshed, the entire area which can be seen from the River was recorded.

As its most basic function, VIEWIT maps those areas which can be seen from user specified viewpoints. These visible areas are printed on maps which show the total number of times each area was seen, relative to the number of viewpoints and their location on the map. The visual analysis of the Missouri River in this project uses this basic function. The more times an area is seen, the more visually vulnerable that area is.

1/ Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

2/ Landscape Architect, Montana State Office, Bureau of Land Management, Billings, Montana, original paper by Tomm Van Dyke, 1977.

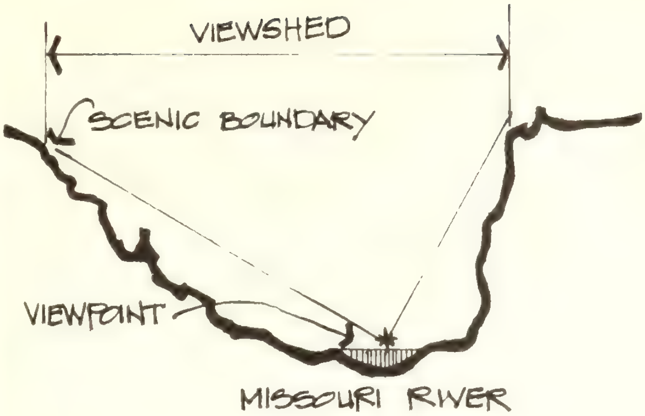

FIGURE 1

Elevation Base

Before using a computer system such as VIEWIT, the elevation information on a standard contour map must be converted to a form which can be recognized by the computer. VIEWIT uses a grid system topography in which each grid cell is 1/5" long and 1/6" high. On the standard USGS 7-1/2 minute quad maps used in this project, this translates to a scale of 333' x 400', or an area of 3.1 acres per grid cell. Thus, the transformed elevation map appears to be a giant blocked landscape where each block, or grid cell, has its own single elevation. (Figure 2)

The grid cell elevation base for this project was acquired from the Defense Mapping Agency (DMA) in the form of computer tapes. These tapes must be translated in order to produce the gridded elevation maps compatible with the VIEWIT system. This process is discussed in a later section.

The specifications of these DMA tapes do not exhibit a great degree of accuracy or detail. Large projects requiring less detail will find these tapes to be an acceptable source of elevation data, especially in terms of cost. Alternate means of acquiring a topographic data base include in-house hand digitizing and contract digitizing. Though the accuracy achieved with these options can be greater, time and money costs are also much greater, being prohibitive in a project as large as this. Small projects needing a great degree of accuracy and detail are best suited to these alternatives.

When choosing an analytical tool, such as VIEWIT, and a source of the base data, such as DMA tapes, it is important that both serve the intents and purposes of the final analysis. Therefore, balancing the analytical tool with the final product it is necessary to match the detail of the project's input to the detail of decisions which have to be made using that product.

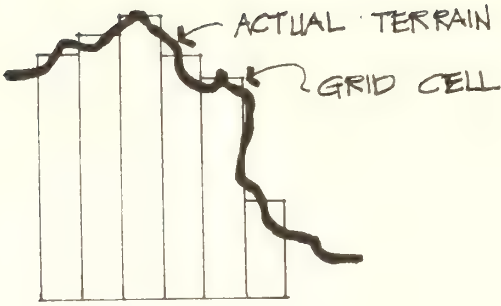

FIGURE 2

Dma Character

DMA information has been interpolated from USGS 1:250,000 scale maps. Each 1:250,000 map is 1 degree in latitude by 2 degrees in longitude. The DMA tapes are set up so that each file on the tape contains a 1-degree by 1-degree portion of the earth's surface, that it, two files for each 1:250,000 map (fig. 3). These are specified as map-half east or map-half west.

The files specify elevation values on a 200' grid. To convert this 200' grid to the 333' x 400' rectangles, the TOPAS computer program COPYNCIC was used, which is simple to use, but quite expensive.

A complex situation occurs when the study area is contained within two or more adjacent map-halves, thus different data files. Joining the east and west portions of the study area is most easily accomplished. Since the data on the tapesare stored by columns, the east portion of the study area can be added to the west portion by using the Univac Text Editor. It becomes most difficult to join concurrent north-south map halves due to this "by column" format of data. The TOPAS programs SCANDTIS and ARRAY can be used to accomplish this step. Because of the time and cost parameters of this project. these programs were not used for this study. This has implications in the final uses of the output, and will be discussed later.

In more detail, DMA information has a maximum deviation of no more than 400' for any spot elevation on the horizontal plane. When considered in light of our grid cell size, this

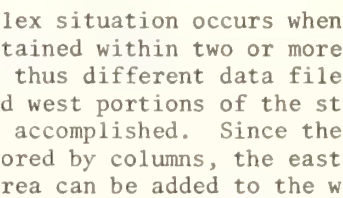

FIGURE 3

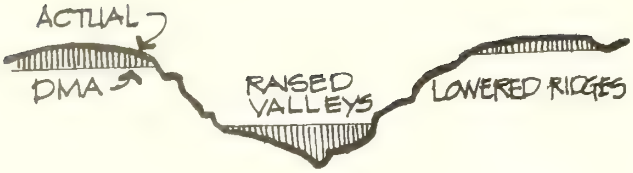

FIGURE 4

means that any cell may be off no more than one cell in any direction. Also as specified, the error in the vertical dimension may be off no more than 100'.

When these error margins are considered within the steep topography of the Missouri River Basin Landscape, the total effect on the accuracy of the mapped viewshed will generally be insignificant. This error margin could obviously be much more devastating on a flatter, undulating landscape.

Another problem we observed in using DMA information is that of truncation. For example, a V-shaped valley may be interpolated to a trapezoidal shaped valley within the DMA tape (Figure 4). This problem should be remembered in reviewing the final VIEWIT maps.

Also, the first elevation maps from the DMA tapes should be carefully checked to make sure the topography has not shifted to an incorrect location. Spot checking major land forms, and high and low elevations will quickly aid in this process.

In the final review, the DMA tapes serve the functions of this project within the allowable error margins. The combined error margin within the DMA detail, both horizontal and vertical, will probably never exceed three cells. Rather than producing a boundary "line" for the River's viewshed, a zone of three or four cells exists along the mapped rim-to-rim boundary (Figure 5). Since the low elevations of the River are mapped somewhat higher and the high elevations of the rims are mapped somewhat lower, the mapped viewshed is a maximum viewshed. This then ensures that the total viewshed has been mapped.

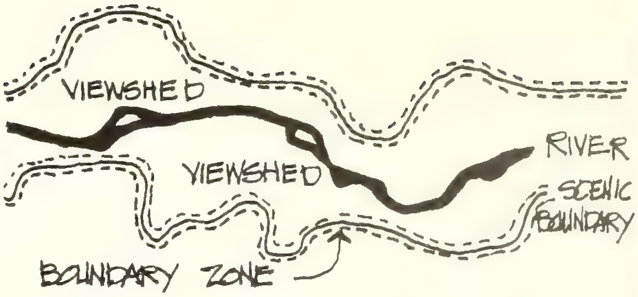

FIGURE 5

DOCUMENTATION OF THE PROCESS

Because DMA data and VIEWIT could be used most easily at the USGS 7-1/2 minute quadrangle scale, the study area was based on the entire quadrangle maps which contained the River in order to map the probable viewshed and boundary determination.

A quad by quad review of the area was initated by marking highest and lowest elevations and the difference between the two, along with an estimate of what areas might occur in the viewshed. A preliminary estimation of where the most appropriate viewpoints would occur in the viewshed was recorded for each quad as shown in table 1.

The purpose of this record was to assist in selecting elevation intervals, and to keep a running total of the viewpoints for cost estimates and later project evaluation.

Upon completing this review, we then considered the total number and area of the aggregate maps we would use in the project. This presented a problem in study area continuity since the area of the project was so large.

The storage capacity in using VIEWIT limited us to a total map area of four total quads. Since there are 26 quads to be used in this long, linear study area, the how and where of joining these maps had to be considered next. This presented an important problem. If viewpoints are placed to the very edge of a map, the areas which can be seen from that viewpoint, but exist on an adjacent map, will remain unrecorded (fig. 6). In order not to lose this information and to maintain a high level of accuracy, a system of overlap was developed. The area of overlap consists of entire quad maps.

Table 1

VIEWPOINTS			Quad Name	ELEVATIONS		
3rd	2nd	1st		High	Low	Diff.
	15	21	P & N Ranch	3400'	2400'	1000'

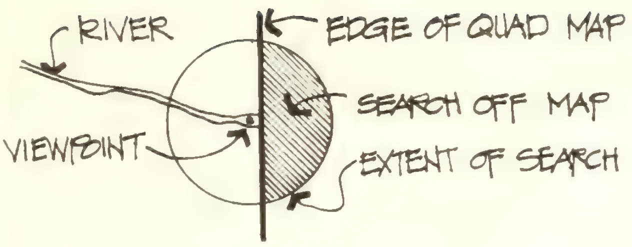

FIGURE 6

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Using this system then, the radius of the search from a viewpoint (r), should equal the distance that last viewpoint is placed from the edge of an overlapping map. A seen area is never lost by a viewpoint "looking off the map." By overlapping map one onto map two, the total seen area along that section of the River is accurately recorded. (Figure 7)

The disadvantage of this method occurs as the total number of aggregate maps for the study area is almost doubled. Also, when figuring the total number of times seen for a cell within the overlap, we are forced to add the numbers from both maps using a light table. This is time consuming. The greater accuracy achieved overrode this inconvenience and slightly higher costs for this project.

Also, due to the problem of overlapping the 1 degree by 1 degree DMA map halves as discussed earlier, the overlap of aggregate maps was not always possible for this project. Several joints do occur which must be interpolated for purposes of continuity.

Elevation Maps

As mentioned before, the DMA elevation information is converted to the grid cell size of 3.1 acres by using the TOPAS program COPYNCIC. A map of the coordinates of each quad in the DMA 1 degree by 1 degree file can be obtained by using the TOPAS program PRINT.

The task now is to create the four-quad aggregate maps on which VIEWIT can function. The STAR*GRID program (PSW*VIEWIT.DMA) groups this information into the desired aggregate maps, and stores them under a user-specified name. In

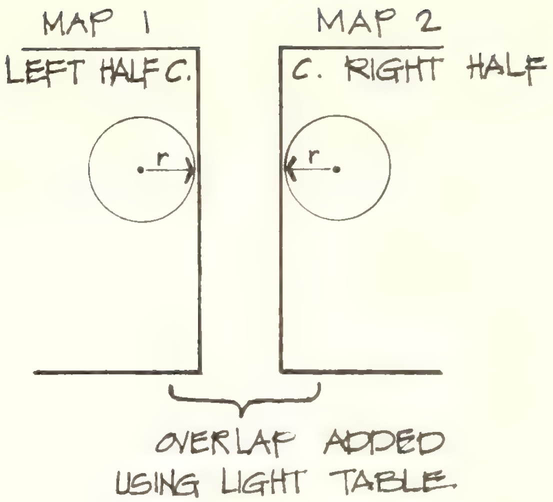

FIGURE 7

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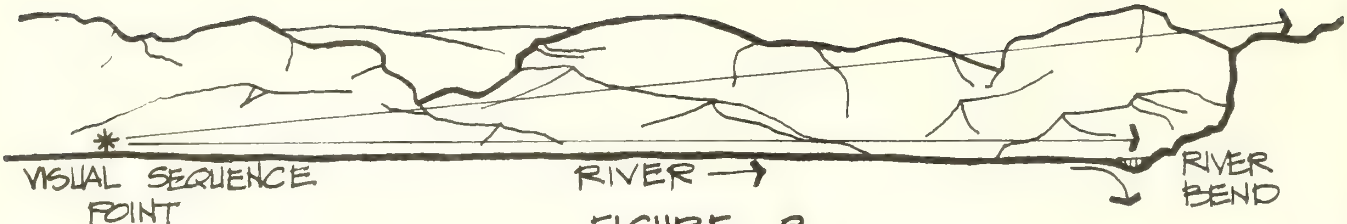

FIGURE 8

gate, and whether it is an east or west data file. The number of rows and columns which appear on this map must also be specified. An example of this computation also appears in the appendix. The x,y coordinates of the southwest corner of the desired aggregate map must also be specified as they appear on the PRINT output, expressed in hundredths of an inch.

When STAR*GRID has been successfully performed to create the new base map, we have the option of immediately specifying elevation classes, and producing an elevation map. This map is numerically coded, based on our elevation classes. A cell in interval "1" receives a "1," a cell in interval "2" receives a "2" and so on.

The purposes of producing these elevation maps from the newly created files which contain them are first, to ensure that the desired area has been correctly transferred from the DMA map-half, and secondly, to check the accuracy of the elevation information (by class) with the correct placement of major landforms. Finally, to provide a gridded base map of the area with which the user can accurately determine the x,y coordinates of the viewpoints which are to be specified in the subsequent VIEWIT runs.

Selecting Viewpoints

When the elevation maps had been produced and verified, the next step was to determine the final viewpoint locations for use in the VIEWIT runs. This selection process is perhaps the most critical step in the entire project process. Since the final VIEWIT output is the direct result of the combined functions of each viewpoint, its own location and relation to the adjacent viewpoints.

In the preliminary review, more viewpoints were included than are really necessary for optimal coverage of the viewshed in the most efficient means. The mind cannot see, from the plan view, the complete potential of each viewpoint with the same totality and speed characteristic of the computer. This limitation creates a tendency for the user to oversaturate the study area, not allowing for maximum efficiency.

The goal in this selection process is to strike the balance between input and output, to reach the fine line where total coverage of the viewshed is contained without unnecessary, repetitious viewpoints. Two factors were considered.

The first factor was the characteristics of our elevation base data which VIEWIT uses. The complex features of the DMA terrain were averaged into a single elevation for each cell. This becomes, in fact, one advantage of this system. A total approach to the landscape ignores the tiny details by reviewing the whole. These small deviations would most likely be included in the final viewshed even if considered, but since they are averaged out, allow the system to function at a more simple, less costly level, with comparable results.

Secondly, a more important consideration in choosing viewpoints is the actual character of the study area terrain. Within the Missouri River Basin, a viewer is dominated by steep slopes and cliffs which rise ruggedly from the River in a closed rim-to-rim landscape. The viewer is inferior, that being the position from which he must look upwards to perceive the landscape.

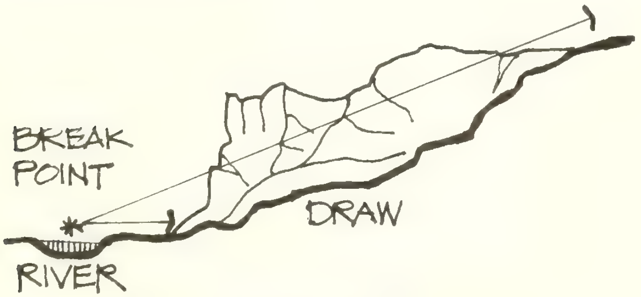

FIGURE 9

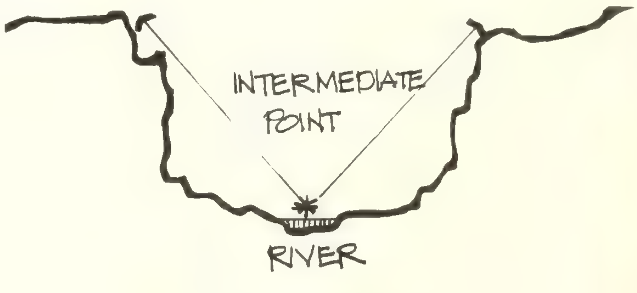

FIGURE 10

From this position, and within this terrain, we found that there are three basic types of views perceived from the River. We used these three types of views in a methodology for placing viewpoints along the River. The three basic types of views are from Visual Sequence Points, Intermediary Points and Break Points.

Visual Sequence Points (Figure 8)

From the visual sequence points, the observer can see the longest views possible along the River corridor. These points occur at the locations where the River bends, opening up new and distant views parallel with the River. And since the views are long, the angle of observation is the smallest. Thus, a distant, potentially grandiose view is possible, providing a wide lateral angle which allows a more comprehensive perception of the landscape whole. There is not a large number of views along the River, and those views that do occur are even more important to map because of this unique visual experience in a closed landscape.

Break Points (Figure 9)

The break points occur at those locations where the eroded draws have broken the immediate wall-like topography of the River landscape. The observer has moderate distance views towards areas beyond the River landscape, but more narrow in scope. The frequency of the views allows for a more varied visual experience along the river. These areas of visual variety should be carefully mapped in order to include them within the viewshed, even though the actual amount of time they can be observed may be relatively short.

Intermediate Points (Figure 10)

The coverage of the total viewshed was completed by using the intermediary viewpoints. These points function in order to fully scan the immediate topography along the River, generally occuring in those intervals between the previously mentioned types. During the initial review of the terrain in this River region, the maximum interval between viewpoints averaged 4 per mile.

By more strategically placing viewpoints, based on view types as defined by the possible views within the terrain, the 149 mile stretch of the River was mapped by using a total of 450 viewpoints. Thus, averaging 3 viewpoints per mile.

It becomes obvious also that the role of a single viewpoint can encompass any combination of the roles described above. And certain viewpoints even act as all three. This overlap allows elimination of duplicating viewpoints.

Selecting Radii

Keeping in mind the three basic types of viewpoints and the role of each, the radius (limit) of the search for visible terrain which the computer uses in the VIEWIT run was determined. Since the role or roles of each viewpoint have been determined in the placement methodology, the farthest possible viewing distance from the viewpoints can be measured to determine the radius of search.

In this project, the maximum radius was ten miles and the smallest three miles. The visual sequence points, by definition, had the largest radii, being six, eight or ten miles. The break points were generally assigned a more moderate distance, usually four or six miles, with some three, eight and ten mile searches for unique situations. The intermediate points were always assigned a three mile radius of search.

Due to the rugged topography and ambiguous viewshed judgements caused by such a topography, the three mile minimum was set. This system of assigning radii for each viewpoint helped to maintain as accurate and complete a set of final views as could be achieved using the VIEWIT method.

Implementation of VIEWIT

With the locations and radii of the viewpoints finalized, these points were transferred onto the elevation maps which were created earlier. This was done on a light table by overlaying the USGS quad map transparencies (with viewpoints drawn on) onto the elevation map computer printouts. Then the row and column number of the viewpoint, along with its radius, can be entered into a VIEWIT run-stream. A ZBIAS of six feet was set. This command allows raising viewpoints six feet above the surface of the river which would be a more real-life situation, as if a floater were to be in a canoe or boat on the river.

Map Preparation

With the completion of this process, the final output is in the form of a numeric map which shows the viewshed of the Missouri River.

In order to provide orientation and scale to major topographic features, such as the River, color-code viewpoints (the color denotes various radii) were added to the computer maps. With these, any user can quickly understand the basic information which produced the map. To aid the interpretation process further, both acetate grids and acetate USGS quad maps are provided for the user. These allow more detailed examination of the maps, enabling a deeper understanding of the implications and possible uses of this output.

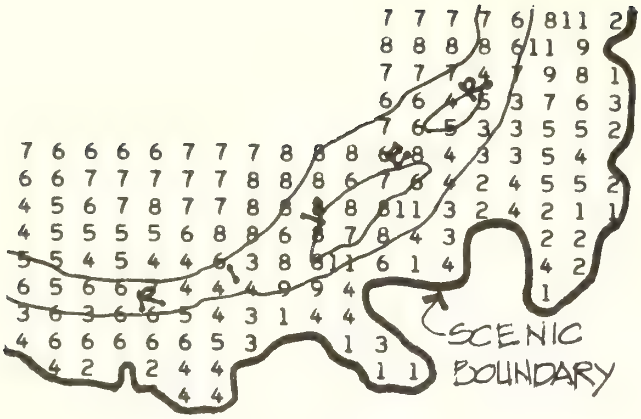

FIGURE 11

By using this simple computer map preparation, a user can better understand how the maps were made, what they mean and how they can be used.

SYSTEM USES

There are several specific uses of this data which relate to the intents of this project. The following are those used during this project and as ongoing possibilities with a system such as VIEWIT.

Scenic Boundaries (Figure 11)

This application of the viewshed maps is perhaps the simplest, but by no means the least important. This, in fact, was the major objective of this project, with the alternate uses being beneficial potential by-products of this system.

In its simplest form, VIEWIT mapped the viewsheds along the River based on the viewpoints as specified. The farthest extent of this viewshed from the River is the Scenic Boundary, that being the rim-to-rim boundary we were to locate and map.

Before using this system, scenic boundaries were determined by hand/map methods, based on field and topographic map observations. By floating down the River and spot checking with a helicopter, general "seen areas" are noted on a base map of the region. Unlike the computer method, this system does not allow for a complete and comprehensive scan from a large number of viewpoints.

There is a tendency with this method to consider only the shorter views. This means that many areas which can only be seen from greater distances will remain unmapped. Also, it becomes hard to map the landscape seen in three dimensions onto a two-dimensional base map.

Table 2

Class	Times Seen	Length of time visible in minutes[1]
1	1	5
2	2-3	10-15
3	4-5	20-25
4	6-7	30-35
5	8-10	40-50
6	11-14	55-70
7	15-18	75-90
8	19+	95-2 hr +

[1] based on a river speed of 4 miles per hour and approximately, 3 viewpoints per mile

These judgment errors make necessary more generalized scenic boundaries. The scenic boundaries interpreted from VIEWIT viewshed maps are based on a much greater degree of detail (Litton 1973).

As a comparison, the scenic rim-to-rim boundaries mapped with the eye/hand method were overlayed with the boundaries derived from the VIEWIT viewshed maps. Overall, the two boundaries were more similar than different. In conflict areas, field checks were necessary.

In a practical sense, seen areas from the final scenic boundary should be included. This could mean that a land use could occur in that area which would be unregulated and remain unmanaged. Thus it could potentially have an adverse impact on the scenic quality of the River. By the same right, including areas within the scenic boundaries which are not visible means unnecessary acquisition costs, restrictions and management costs.

Visual Vulnerability

Using VIEWIT maps, this analysis can be taken one step farther. On these maps, the number of viewpoints which "see" an area is recorded in every cell of the viewshed. Though this does not take into account the quality of the view, it does make it possible to rank these areas based on how often, thus how long they can be seen. By this principle, if an area is seen more times, it is seen longer and is consequently more visible. Based strictly on time, the areas which are most visible have a higher visual vulnerability than those areas which are less visible. These areas must then be more carefully managed since an activity which occurs in those highly visible areas could have a greater impact on the scenic quality of the River. Though oversimplified, this concept can be useful in the management activities along the River.

In mapping relative visual vulnerability along the River, we assumed that:

A To be used as a planning tool for siting necessary structures and activities in the viewshed, areas of lowest visual vulnerability should be shown in more detail. More distinctions should be drawn at this end of the scale between the number of times seen as low number of times seen means less amount of time visible with lowest possible impacts on scenic quality making more attractive sites for an activity; and, the converse is also assumed.

B. Management on areas of higher visual vulnerability requires fewer distinctions. Lengths of time seen tend to lose significance as they increase. The difference between 60 and 70 minutes of visibility is academic for siting and controlling impacts on scenic quality.

Applying these basic assumptions, the visual vulnerability zones were based on the classes as shown in table 2.

Planning/Design, Decisions

When a siting decision for a land use or activity has been made within the viewshed of the River, its visibility and visual impact can be measured with the help of VIEWIT. If a viewpoint is placed on the uppermost structure of a land use, like the top of a utility pole, bridge or well, all areas from which that structure is visible would be mapped. This can be the base from which other issues can be considered such as possible versus probable perception, screening and the like.

This technique can be used for choosing several possible sites and then narrowing them down to the one at which the visual impacts on the River will be the least. This should be an important part of the site analysis and selection criteria.

It should also be noted that detailed decisions such as these probably necessitate more exact elevation data such as that produced by hand digitizing methods.

CONCLUSION

In the final review of this project, the DMA data proved to be an adequate source of elevation information for the purposes of this project. Data orientation, that being the actual spatial placement of the correct elevations on the map was quite accurate. It was found that because of the truncation problems as discussed earlier, the extreme high and low elevations in the landscape tended to disappear. The high and low elevation checks as built into the assignment of elevation classes were in fact never violated. Instead, the elevation class for the River often disappeared, as did the #9 class containing the highest elevations. This made it all the more necessary actually to draw the River onto the elevation maps to provide for basic orientation.

This tendency to raise the River and lower the ridges implies that the mapped viewshed may be somewhat larger than the viewshed which actually exists. This problem was not critical for the project. In this region, and for this resource, the exclusion of visible areas from the viewshed is a more serious problem than the inclusion of a slight area of nonvisible cells. The generalized 40 acre grid used for final legal boundary definition also negates this problem.

When reviewing the final VIEWIT maps, it was found that the viewshed in several flatter areas appeared to be less accurate than the viewsheds for the steep areas. It appears that caution should be used when DMA data is applied for flatter, undulating landscapes. Both truncation and error margins have a much more pronounced effect in these landscapes. A test of accuracy should be made to ensure the effective use of DMA data for these areas.

The steep terrain of the Missouri River landscape served as an optimal use situation, that being one in which the effects of both truncation and specified vertical and horizontal error margins are reduced. This advantage, along with the relative ease of operation and economic advantages made the DMA source a good alternative for this project.

In producing the final viewshed maps, the methodology for viewpoint selection proved to be successful. When comparing the VIEWIT viewsheds with the USGS quads and the eye/hand boundary maps, there was a general correlation and verification of information.

In mapping the final scenic rim-to-rim boundaries, the user should keep in mind the error margins as discussed earlier. The outer edge of the viewshed delineates a boundary "zone," rather than a distinct line. This zone must be kept in mind when the final 40 acre legal boundary is mapped. Field checks should be made to verify any questionable situations.

The far reaching implication of the viewshed and system data shows the advantage of using a computer system such as VIEWIT. Its potential goes beyond strictly delineating viewsheds and scenic boundaries, being able to perform also as a planning/management tool.

This was the first time that actual graduations of visual vulnerability within the scenic boundaries were mapped. Also, a quantitative measure was assigned to the viewpoints along the River since the total acreage of seen areas is recorded for each separate viewpoint.

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Appropriate Combinations of Technology Landscape Management for Solving Problems—

Session L: Outer Continental Shelf and Coastal Energy Development

Managing the Visual Effects of Outer Continental Shelf and Other Petroleum-Related Coastal Development[1]

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and
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Abstract: Five petroleum-related facilities often sited in the coastal zone during development of Outer Continental oil and gas can change the visual appearance of coastal areas. These facilities are service bases, platform fabrication yards, marine terminals and associated storage facilities, oil and gas processing facilities, and liquified natural gas terminals. Examples of innovative approaches to managing the visual impacts of these facilities are discussed. Subject areas requiring additional research are identified.

INTRODUCTION

In this paper we discuss issues related to the visual impact of Outer Continental Shelf (OCS) and other petroleum-related coastal development: 1) The OCS oil and gas development cycle; 2) the visual effects of service bases, platform fabrication yards, marine terminals and associated oil storage facilities, oil and gas processing facilities, and liquified natural gas (LNG) terminals; 3) innovative visual management strategies designed to mitigate the impacts of these facilities; and 4) subject areas requiring further consideration by the planning and research community.

Why should OCS or other petroleum-related coastal energy development be of concern to visual planners?

First of all, the leasing of offshore tracts on the federally owned OCS through 1985 is planned for areas of New England, the Mid-Atlantic, South Atlantic, Gulf of Mexico, Pacific, and Alaska. The amount of imported oil has increased tremendously since 1973. Right now we import about 50% of our oil. Imported oil must be brought ashore, usually through a tanker terminal and associated storage facilities. In addition, there are a number of proposals to import liquified natural gas, which will also require terminals on the coast to receive and regassify the liquified natural gas (LNG).

Most of the visual impacts of OCS development will be from the onshore oil and gas related facilities rather than from the offshore platforms. Because most lease areas are far out at sea, in most coastal areas the offshore platforms will not be visible from the shore. The exceptions to this occur in the Gulf of Mexico, Southern California and the upper Cook Inlet of Alaska.

Petroleum-related coastal development is a large scale industrial activity. The facilities directly required to support OCS or other oil and gas development, such as platform fabrication yards, or processing facilities are massive and are of an appearance which may restrict our options to mitigate their visual impacts.

Another consideration concerning the visual impacts of these facilities is that offshore technology, and the onshore facilities supporting offshore operations, is a foreign technology to most regions of the country, with the exception of parts of Texas, Louisiana, Southern California and Alaska.

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as in the case of the VIEWIT computer visibility model. This type of approach can deal more effectively with the problem of simulating a great many different viewpoints within a complex landscape, to determine what would in fact be visible from each viewpoint (Amidon and Elsner 1968). In general, many of the techniques are concerned with producing a map of classified impact areas, including such factors as number of persons perceiving the scene, the duration of time involved, the distance from the viewpoint to object, and the percentage of the viewscape dominated by the facility.

A composite approach derived from these sources can be described as follows:

--Visual characteristics of each landscape unit are determined, and changes of these characteristics with the proposed facility are described. Landscape units include landforms and land cover patterns. A rating can be assigned to measure extent of change. Visually fragile areas would have a high damage rating.

--Areas of increased viewer sensitivity are identified, often by using surveys of residents to determine preferences. Special attention is given to viewpoints defined by major roads or other high-exposure points or lines. The intensity of use of these points determines the number of people exposed to the facility site.

--Potential mitigation techniques, such as screening, facilty design, and micro-scale siting approaches are considered. See the next section for a detailed example.

--Future land uses are mapped for compatibility of visual impact.

--Overlay maps are combined to produce a final suitability map. Individual maps can contain constraint ratings to be combined to determine areas of highest to lowest compatibility. These ratings can be constructed by selecting viewpoints from which to determine "before" and "after" visual effects. Effects can be simulated by photographs, drawings of proposed facilities, or by computer. Subjective evaluation by a panel or experts can be used also.

--In the case where evaluator's responses are used, a visual quality (VQ) rating for a given viewscape has been suggested as a simple average of intactness, vividness, and unity. Intactness is defined as the apparent degree of natural condition as a function of human encroachment; vividness is influenced by sharpness of boundaries, amount of topographic relief, and contrast in visual elements; unity is a measure of visual harmony or balance influenced by similarity of form, line, color, and texture.

CHARACTERISTICS, VISUAL EFFECTS AND IMPACT MANAGEMENT OF PETROLEUM-RELATED COASTAL DEVELOPMENT

Service Bases

The service base (fig. 1) is the staging area established by an oil company or independent service contractor for shipping equipment, supplies, and personnel to offshore sites during OCS development. The base may include berthage space for 180- to 220-foot supply and crew boats, dock space for loading and unloading supplies, warehousing, open storage areas, buildings to house supervisory and communications personnel, and a heli-pad. The size of the base and level of vessel activity depends on the number and kinds of exploratory vessels and drilling rigs being served, but are usually between 25-50 acres. Service bases operate 24 hours a day on military - like schedules, and must be illuminated during the night. (New England River Basins Commission 1976). As mentioned earlier, service bases are a port-related facility, and have the same general berthage and repair requirements as ocean going fishing vessels. In fact, in Scotland some of the bitterest controversies were over who had the rights to the wharves in Aberdeen and Peterhead, the oil men who could pay high leases or the traditional users,the fisherman. It was only resolved when new piers were built for the service bases (Baldwin and Baldwin 1975).

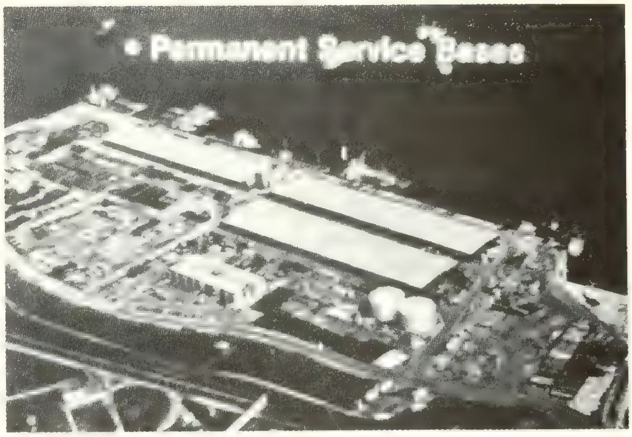

Figure 1--A service base which supports OCS development in the North Sea.

Since a key locational criterion for service bases is distance to the offshore tracts, there isn't always a perfect port location available, particularly in remote or sparsely populated areas. The service base at Norscot, in the Shetlands had to be constructed from scratch, and is a foreign element to the island. An area like the Shetlands presents difficult visual design problems. It is an

OCS OIL AND GAS DEVELOPMENT CYCLE AND ASSOCIATED FACILITIES

Onshore facilities and impacts are triggered by offshore development activities, and are directly related to offshore activities.

OCS development occurs in three stages following the leasing of offshore tracts; exploration, development and production. There is considerable overlap between stages.

The New England River Basins Commission identified 10 facility types that are likely to have significant visual impact (NERBC, 1976). These facility types are:

1. Service Bases
2. Pipelines
3. Marine Terminals
4. Gas Processing Plants
5. Petrochemical Plants
6. Repair and Maintenance Yards
7. Partial Processing Plants
8. Refineries
9. Platform Fabrication Yards
10. Pipe Coating Yards

There are specific onshore facilities related to each stage of offshore development. Service and support facilities (1, 6) are established soon after leasing and continue functioning through the development cycle. Platform fabrication yards (9) are established only after sufficient oil and gas have been discovered to justify a platform construction facility. Transportation and processing facilities (2, 3, 4, 5, 7, 8, 10) are constructed during the development stage of OCS oil and gas resources and come into operation during the production stage. The duration of the OCS development cycle can be surprisingly long--as much as 30 years.

OCS development isn't instantaneous, so there is some time to plan for facilities. Once oil and gas are discovered the pace of activity can accelerate tremendously. Onshore activities and facilities will begin appearing long before the first drop of oil comes ashore.

We can categorize onshore OCS-related facilities in a number of different ways besides the stage of development in which they are required. Certain onshore OCS-related facilities are port related, while others are not.Service bases are a port-related facility. If possible, industry would prefer to locate a service base in an already existing port area. Platform fabrication yards are not port related but are still coastal dependent. They require direct water access. Other facilities, particularly processing facilities like oil refineries or gas treatment plants don't require water access.

VISUAL IMPACT ASSESSMENT FACTORS

In general, important characteristics of facilities and viewers include:

1) The location of the project, e.g., in a rural or urban setting. In a rural setting, micro-level landscape characteristics can be important. In an urban commercial setting, nearby land uses may be compatible because of pre-existing port facilities or related energy establishments. In extreme cases, virtual "energy parks" are already in existence that consist of a complex of energy and transportation facilities, for example in parts of New Jersey.

2) The physical size of the facility relative to its surroundings. The areal extent of the facility.

3) Duration of exposure to visual impact. Construction, operation, and maintenance often involve very different procedures and lead to great variation in visual impact over time. As community development occurs, at least some facilities will exhibit a transient rather than permanent nature. In one study done on the cumulative impacts of onshore oil and gas facilities, the major land use impact peaked within 10 years and was at only about one-half the peak level twenty years after initiation (Smith 1978). This can mean decommissioning and removal of the objects causing visual impact; it can also mean deterioration, neglect, and very poor visual quality after a period of years.

4) The expectations of the viewers. A single large facility in a rural community presents a much sharper contrast than a facility clustered with other similar land uses. It is likely that the visual expectations of the viewers in a community totally devoted to energy development is different from those expectations of viewers from other communities. Viewer expectation affects perceived visual impacts. Morgan City, Louisiana bills itself as the "offshore capital of the world." People live there, on the average, for about 4 years, and they may have minimal expectations about the quality of the visual environment during their stay. Morgan City is not devoid of visual amenities, as there are parks and open space. But there are no visual criteria applied to the industrial facilities, which dominate the central community district.

Utilizing the existing environment as a baseline from which to measure change, a vital step is to provide some measure of the impact of a proposed oil and gas facility. A number of approaches are available for this purpose, sometimes originally developed for evaluation of other types of artificial structures imposed on the landscape (Vaugh 1974, and Battelle 1974). The method used can utilize advanced computer technology, area of basically low relief, vegetated with grasses and shrubs but not trees. It is very difficult to integrate an industrial facility into this environment.

Platform Construction Yards

"Steel platform fabrication yards (fig. 2) are large, water-front facilities, consisting mostly of cleared land, buildings, shops, and administrative offices set back from the waterfront. The steel platforms are constructed close to the waterfront at marginal wharfs. Industrial infrastructure--roads, railroads, power lines, etc.--is evident.

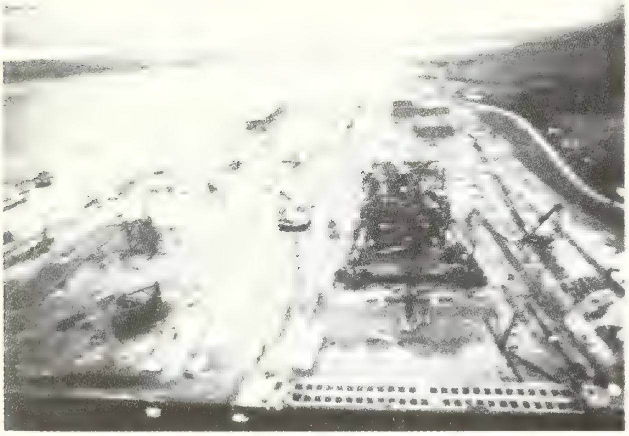

Figure 2--Platform fabrication yard.

"The layout, requirements and impacts of the fabrication yard are determined, in large part, by the number and complexity of platforms being constructed. The size of the yard depends upon the size and number of platforms constructed annually, as well as the number of platform components fabricated on the site.

"A platform yard does not have to be sited in the lease region; one yard can service several adjacent lease areas. Platforms are commonly constructed far from the lease area and towed long distances to the site. If a fabricator does choose to build a new facility in a frontier area it will be established only after a significant find has been made, its size has been determined, and the development schedule has been set."(New England River Basins Commission 1977).

Factors affecting the location of platform construction yards include the cost of transporting platforms to the OCS, the availability of skilled labor, and a mild climate, if possible, which favors year round operations. Platform fabrication yards require a large, level site of from 200-1000 acres. This is too much land to be economic in an already developed port area, so these yards will often be located in rural coastal communities.

Platform fabrication yards are very visible, and present great difficulties in mitigating their visual effect.

Concrete platform fabrication yards differ from steel platform fabrication yards in that deeper water is required adjacent to the site: about 35-50 ft. at the pier, and 150-300 ft. within several hundred yards. The 30-80 ft. bases are constructed in a dry dock and then floated a few hundred yards at most to very deep (150-300 feet) water for construction of the tall pillars upon which the deck section is attached. Thus the single most important requirement is a large open site with immediately adjacent very deep water (New England River Basins Commission 1977). The requirement for adjacent deep water presents a potential conflict between concrete platform fabrication yards and other uses. In the North Sea, fjord-like sites were selected both in Scotland and Norway for these facilities. In Scotland this caused bitter conflicts. In Norway, the government arranged a form of compensation for the impacts of the yard at Stavanger. The developer agreed to construct a pleasure boat marina in exchange for approval to locate the platform fabrication yard. At present it is unlikely that concrete platform fabrication yards would be required in the U.S., with the only remote possibility being in Alaska if large amounts of oil and gas are discovere in areas with severe weather conditions.

Oil Terminals and Storage Facilities

Oil produced from the OCS will be transported to shore through undersea pipelines, tankers or barges. The determination of a transportation strategy includes such factors as location and amount of oil to be transported, location of processing facilities, and nature of undersea topography, among others. Imported oil will be transported to the U.S. via tankers.

Marine terminals may serve several functions, according to a report by the New England River Basins Commission (1976):

- load crude oil received by pipeline from offshore production platforms onto tankers for final delivery to refineries;
- receive crude oil from tankers for delivery by overland pipeline to nearby refineries;
- receive crude oil from supertankers and very large crude carriers for delivery to nearby refineries; and

- receive refined petroleum products from tankers and store them for delivery overland to final markets."

Oil terminals which would receive either OCS derived oil or imported oil have two basic components: 1) a port facility to receive or transship oil and; 2) large storage tanks which hold the oil until it can be shipped. Factors affecting the location of a marine terminal include the location of the pipeline landfall, if any, the location of refineries and the presence of deep water (50-60 ft.) close to shore.

The ordinary design of oil terminals is determined by economic and engineering constraints. The marine terminal is water dependent, and although the storage tanks need not be, they are often located at the coast. Both tankers and storage tanks are very prominent objects, which are often visible for some distance. The storage tanks can be as high as 150 ft., and fully capable of dominating coastal horizons.

There have been a number of attempts to ameliorate the visual impacts of oil storage facilities. The Baldwins (1975) describe an effort by British Petroleum (BP) to locate their storage facilities associated with a tanker terminal in the Firth of Forth:

> Local authorities encouraged BP to avoid placing unsightly oil storage tanks along the banks of the scenic Firth of Forth. Instead, BP created a tank farm three miles inland at Dalmeny, in the midst of a huge hollowed out mountain of oil shale tailings which has been carefully landscaped to screen the tanks from public view.

Milfordhaven is a large oil port on the coast of Wales. There are numerous oil storage facilities present, many of which are quite prominent. However, there have been attempts to hide or at least diminish the visual impacts of these facilities. One technique masks the full height of the tanks by placing them in a recessed area and surrounding them with an earthen berm. This has the effect of placing them below the horizon and exposing only a fraction of the tanks to view.

Oil and Gas Processing Facilities

Oil and gas must be processed before commercial use can occur. In general gas processing facilities do not require large amounts of land, usually about 50-75 acres, of which only 20 acres is actually built upon (fig. 3). As documented by the New England River Basins Commission (1977),"Similar in appearance to a refinery though smaller, a gas processing and treatment plant is designed to strip impurities and valuable liquefiable hydrocarbons, such as ethane, butane, and propane, from the raw gas stream before it enters the commercial gas transmission line. There are no standard sizes or designs for gas plants; a plant is specifically designed for the gas stream it processes and may range in throughput capacity from two million cubic feet per day to two billion cubic feet per day. Gas plants generally have a life of from 10-20 years, depending upon the availability of the natural gas supply."

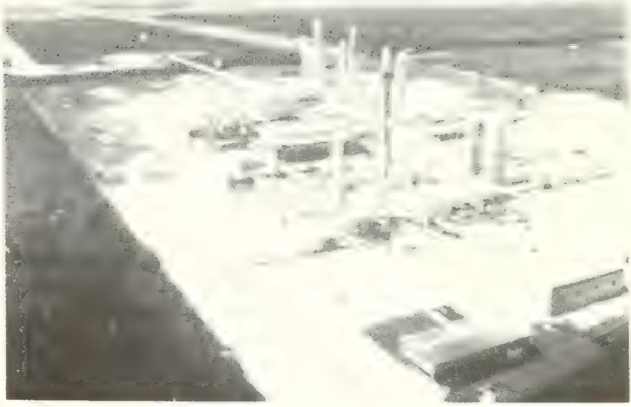
Figure 3--Natural gas processing plant.

Facility siting considerations for gas processing plants include the size and quality of the gas discovered, the location of the pipeline landfall and the commerial gas transmission lines (as the plant must lie between the two) and, whether the plant will provide feedstock for the petrochemical industry.

A gas plant often has tall vertical stacks and pipework which can contrast sharply with the surroundings. Because of safety considerations gas plants are often sited in rural areas.

The St. Fergis gas terminal in Scotland has an appearance strikingly different from that of more traditional gas processing facilities (fig. 4). The final visual design of the plant was developed

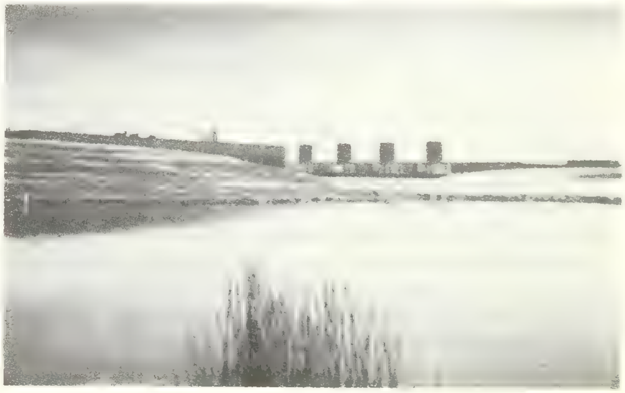
Figure 4--St. Fergis gas terminal, Scotland.

collaboratively by the energy company and the local planning authority. Much of the tall pipework has been hidden, some of it in lower black utility structures, which greatly reduces the vertical dimension of the plant. In addition, at the request of the planning authority, the company agreed to design a circular fire pond with some provision for wildlife habitat, rather than the standard rectangular design.

"The modern refinery is a series of processing units designed to produce a number of petroleum products by physically or chemically altering all or part of the crude oil stream. How complex the refinery is depends upon the type of crude oil being refined and the number and kinds of products desired. Complexity generally increases as the percentage of gasoline and other 'light' products produced increases. A typical refinery will include processing units, storage tanks, water treatment facilities, offices, machine shop, storage and warehouses, electrical substation, firehouse, pumping station, truck loading areas, pipelines, rail spur, parking areas, and a buffer zone. Refinery sites are often large (1000-1500 acres for a 250,000 bbl/day) but with only a small percentage of total area in intensive use."(New England River Basins Commission 1977).

There is no direct correlation between oil production on the OCS and development of new refinery capacity. It is expected that OCS oil will substitute for imported oil for use in refineries. The basic refinery siting considerations include the existence of a market for refined products, the assurance of a long-term supply of crude oil to assure that plant capacity factors can be met, the availability of land and water and the ability of the plant to meet air and water quality regulations.

Refineries, due to their size and significant contrast with any but industrial uses, present substantial challenges to visual impact mitigation. A possible means of managing the visual impact attempted at Milfordhaven was to screen all but several stacks from view behind a large berm.

Liquified Natural Gas (LNG) Storage Facilities

Natural gas can be transported long distances by either pipeline or ship. If pipelines are prohibitively expensive then natural gas must first be liquified and reduced in volume and then loaded onto tankers for transport. This is currently occurring in Alaska, Algeria and Indonesia, among other places. When the LNG tankers reach their destination their cargo is stored in large tanks and vaporized in a plant before entering the commercial gas stream. The primary visual impact of LNG storage facilities is the large storage tanks, of approximately 46 meters high by 46 meters diameter. In 1972 the Boston Gas Company converted an LNG storage area in Dorchester from a grimy industrial site characterized by gray oil and gas storage tanks and outbuildings to a modern-looking LNG terminal and associated park and fishing areas. (fig. 5). Boston Gas had new tanks installed, and commissioned artist Corita Kent to develop a bold graphic for the facility. She designed a rainbow motif of deep blues, purples and greens for one tank and highlighted the otherwise white colored pipework with deep bold colors. The community reaction to the renovation has been quite positive and the facility is considered a neighborhood landmark.

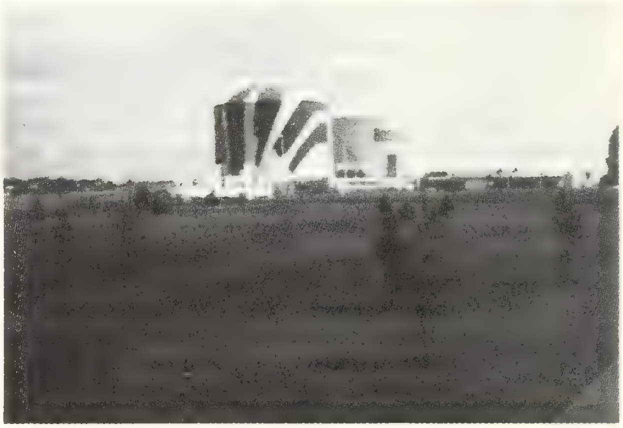

Figure 5--Liquified Natural Gas (LNG) Terminal, Boston Gas Company.

INSTITUTIONAL CONSIDERATIONS

Many of the examples of good visual impact mitigation of OCS or other coastal-related petroleum development have occurred in Scotland in relation to North Sea energy development. The British concern for visual quality is reflected in their planning system which in turn has affected the location and design of these facilites.

Under the Town and Country Planning Act of 1947, localities in the UK zone their lands for development within their jurisdiction. The local or regional plans are subject to approval at the national level. Any proposed development which departs from these plans,such as OCS related development did, must be referred to the Secretary of State for his consent. The Secretary of State is an elected member of Parliament nominated to this cabinet position by the Prime Minister.

Because of this institutional situation, a number of OCS-related onshore facilities received national scrutiny during the siting process. This particularly affected the siting of a concrete platform fabrication yard proposed for the town of Drumbuie in 1973-74. Drumbuie was a hamlet of only 24 people on the west coast of Scotland. The land for the site, moreover, was leased by farmers from the National Trust, a private organization devoted to the preservation of particularly scenic lands. The matter was resolved when the Secretary of State denied a permit for the facility, largely on aesthetic grounds. Approval for the facility instead was given to a site at Kishorn, which was, if anything else, an even more visually attractive location (Baldwin and Baldwin 1975). The visual appearance of OCS-related onshore facilities is an important concern at the local level also. Permitting usually occurs in two steps, both of which involve the collaboration of industry and the local planning authority.

Industry applies for initial "outline planning consent" early in the siting process. Dean and Graham (n.d.) describe the outline planning process as follows:

"During the preliminary stage of site selection, the full-time officers of the local planning authority will be consulted on an informal basis and their views will be taken into consideration. When a specific site has been selected, an application for outline planning consent is submitted, i.e., the planning authority is being asked to approve in principle the development of the site for the required purpose requested, thus allowing the expensive and lengthy planning and design work to proceed with the knowledge that the plant can in fact be constructed, subject to subsequent approval of detail. This outline consent stage is probably the most difficult of all and can be very lengthy-many months or even years."

During the negotiations concerning the granting of outline approval visual considerations become a key factor. After these consultations have been completed the elected members of the Local Planning Committee consider the application. If approval is denied, then the applicant has the right of appeal to the Secretary of State.

If outline approval is granted a second stage of detailed planning consents is initiated. At this point the site plan is extensively reviewed, particularly for actions or structures which may create a visual impact (Dean and Graham n.d.).

The planning framework in the U.S. for OCS and other petroleum related coastal development has been quite different from the British model. Traditionally the authority over the visual appearance of industrial facilities has been solely a local responsibility. Many local governments, in their attempts to lure economic growth, have been reluctant to apply stringent visual controls which would affect the appearance of industrial facilities. Unless state or local lands were affected by these facilities, there was no intervention from those governmental levels into the visual appearance of the facilities.

But now, through the coastal zone management process currently being established, many states are recognizing the importance of the visual resource. Many states are identifying critical visual resources upon which development would be prohibited, and several states are managing industrial development on the coast with an eye for reducing their visual impacts.

The California Coastal Plan has policies to locate industrial facilities away from scenic areas identified in the coastal plan. It also specifically states that in no event is a new refinery to be placed in a highly scenic area. (State of California 1976.)

The Maryland CZM plan states that state approval of an OCS facility will be denied if siting would cause a significant adverse impact on scenic or natural beauty. This also includes development on sites adjacent to scenic areas. (State of Maryland 1978.)

In addition, a number of states which don't have explicit sections on visual quality do have policies on OCS related facilities in the coastal zone. These policies have an effect on where OCS facilities can locate and therefore, on their visual impacts.

One set of policies, followed by states such as California, Maryland, New Jersey and Delaware, is to locate OCS related facilities in already developed industrial areas or in specific areas where oil-related development presently exists.

Another set of policies serves to discourage certain facilities from locating in the coastal zone at all. The New Jersey plan calls for gas processing plants to be excluded from the coastal zone and to be located as far inland as possible, and adjacent to existing petrochemical plants. (State of New Jersey 1978.)

Refineries in California are to be located at reasonable inland sites, and to provide a buffer zone to minimize impacts. This is essentially the same policy which holds in Delaware, whose CZM plan states that direct waterfront access is not required by refineries. (State of Delaware 1979.)

Finally, one policy may be to exclude a facility from anywhere in the State. Delaware did this for LNG terminals for safety reasons.

The visual impact of the facility probably did not play a major role in this decision.

RESEARCH ISSUES

A number of issues concerning how best to manage the visual effects of OCS and other petroleum-related coastal development require further attention by the research and planning community.

1. Studies are required to compare the relative effectiveness of visual planning as opposed to visual impact mitigation. Visual planning seeks to avoid scenically incompatible locations for these facilities. Visual impact mitigation seeks to establish the best design possible for already selected sites. Few studies have been performed in the U.S. or in the UK which have explicitly factored visual criteria into broad regional siting studies. A comparative analysis of the utility of planning vs. mitigation could help planners and designers determine the most appropriate points in the planning process to insert considerations of visual quality and impact.

2. Tests should be conducted, preferably by using simulations or field techniques, to assess the effectiveness of various visual impact mitigation methods. For a given facility, a number of alternative designs may be developed which purport to minimize its visual impact. More information is required to know how these alternative strategies operate in different settings or with different viewers.

3. Compensation should be examined as a form of impact assistance to be provided by industry to adversely affected states or localities. Payments by industry to compensate or assist communities subject to rapid growth associated with energy development projects are being used at present to provide needed roads, water supply, community centers and required commercial development, among other provisions. States and localities should and often do negotiate with energy developers for the terms of impact assistance. The provision of funds to purchase title or scenic easements on offsite lands may be used as compensation for onsite visual impacts which cannot be mitigated. This method can help to internalize the external diseconomics of siting decisions, that is, to represent more realistically the real costs of such decisions and to feed them back into the decisionmaking process.

ACKNOWLEDGEMENTS

The authors wish to thank the following individuals and organizations for making their photographs available and providing their perspective on the visual impacts of petroleum-related coastal developments; Keith Hay, American Petroleum Institute; O.J. Shirley, Shell Oil Company; The Boston Gas Corporation; Maire Murphy, New England River Basins Commission; Barry Lawson, Lawson Associates; David Williams, Managment Consultant; Jack Farlow, U.S. Environmental Protection Agency; and Bob Matthews and Brandon Wilson of the U.S. Geological Survey. Photo credits are as follows: Fig. 1, New England River Basins Commission; Fig. 2, Keith Hay, American Petroleum Institute; Fig. 3, O.J. Shirley, Shell Oil Company; Fig. 4, Total Oil Company, UK; Fig. 5, Boston Gas Company.

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Visual Simulation of Offshore Liquefied Natural Gas (LNG) Terminals in a Decision-Making Context[1]

Brian E. Baird, Stephen R. J. Sheppard,

and Richard C. Smardon[2]

Abstract: Due to legislation passed in 1977, the Coastal Commission took part in a study analyzing potential offshore Liquified Natural Gas (LNG) sites and the types of terminals that might occupy those sites. The study had to evaluate the engineering feasibility of siting an LNG receiving terminal offshore in relation to the maximum protection of coastal resource provisions required by the California Coastal Act. The Coastal Act embodies a broad range of policies for the protection of coastal resources, which includes providing for the protection of scenic and visual resources within the coastal zone. This paper analyzes the use of a visual simulation technique for the siting of offshore LNG terminals and describes how the technique was used to implement the scenic and visual protection policies of the California Coastal Act.

INTRODUCTION

California is facing one of the most difficult energy facility siting controversies in the history of the state. The Liquified Natural Gas Terminal Act of 1977[3] called for various state agencies to participate in the process of siting a liquified natural gas receiving terminal along the coast of California. The California Coastal Commission was asked to do two studies dealing with this siting issue. These included an onshore study to deal strictly with the siting of a conventional LNG terminal at a land based site or sites and an offshore study to determine the most appropriate site(s) and type(s) of LNG terminal combinations that could feasibly be located off the California coast. The onshore study dealt with technical configurations that were relatively easy to visualize (Hibbert 1977) because of the use of conventional looking trestle designs, industrial complexes and storage facilities. The offshore study did not have this luxury due to the many innovative facility designs and possible locations off the California coast. Some of the various offshore terminal concepts studied included island based terminals, deep bottom supported, shallow bottom supported, floating, semi-submersible, and several hybrid land/-sea based concepts.[4] It became clear that it would be helpful to be able to visualize what these facilities would look like at the potential sites being studied. The Department of Landscape Architecture work in the field of visual portrayal studies (Sheppard and Smardon 1978) provided a method that the Coastal Commission could use to demonstrate the visual impact of these facilities at potential siting areas. With the aid of water color paints and special air brushing techniques, the artist added various facility types directly onto photographs of the sites at the proper scale. The visual simulations have been useful to the Coastal Commission during policy decision making, report preparation, and for use at various workshops and public presentations. The process provides an effective vehicle for decision makers, as well as members of the public to evaluate the aesthetic impact of future planned development.

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[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Coastal Analyst, California Coastal Commission, San Francisco, Calif.; Post Graduate Research Landscape Architects, Department of Landscape Architecture, University of California, Berkeley.

[3] Liquified Natural Gas Act Stats, 1977, Chap. 855, Page 2506 (effective Sept. 17, 1977).

[4] All line drawing figures are done by John Van Coops, California Coastal Commission Cartographer.

DESCRIPTION OF THE PROJECT

In 1977 Western LNG Associates submitted the current application to import Liquefied Natural Gas (LNG) from Indonesia and Alaska to a receiving terminal along the California coast. Because of the many unknowns regarding the safe transportation and handling of LNG the state legislature passed Senate Bill 1081, the LNG Act of 1977.[5] The bill established a siting procedure that called for the coordinated effort of three state agencies in determining where the LNG receiving terminal should be located. The Energy Commission was assigned the role of gas demand forecasting, the Coastal Commission the role of site ranking, and the Public Utilities Commission was designated as the ultimate permitting agency. The Coastal Commission was asked to do siting studies evaluating potential onshore and offshore sites along the California coast and to rank the sites under the policies and objectives of the California Coastal Act.[6]

The objective of the onshore study was to locate and rank sites for land based terminals using exisiting technology. Figure 1 gives a layout of a typical onshore LNG receiving terminal which includes a trestle for ship berthing and LNG transfer, LNG storage tanks, LNG vaporizers (conversion back to natural gas), and the natural gas pipeline distribution system. The objective of the offshore study on the other hand was to rank offshore sites and determine what type of terminal should be located at those sites. The various offshore terminal types, whether floating, deep bottom supported, shallow bottom supported, or a hybrid configuration, had to be able to accommodate all the component systems mentioned above for land based terminals (Hibberd 1977). For the offshore study the commission had the role of site selection, terminal feasibility, and protection of coastal resources under the Coastal Act. Senate Bill 1081 specifically states:

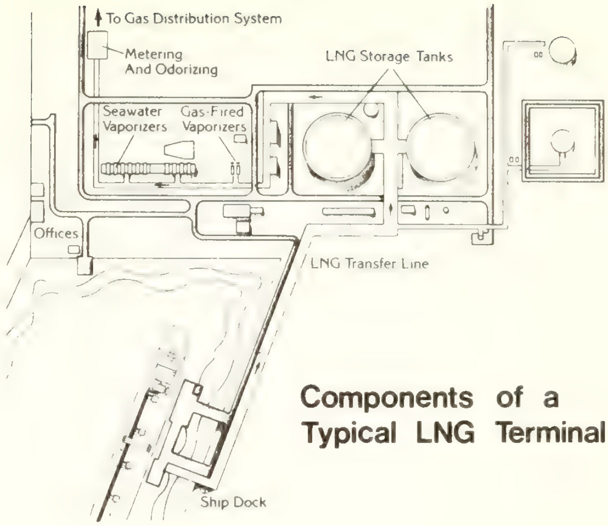

Figure 1--Components of a Typical LNG Terminal

> Not later than 12 months after the effective date of this chapter, the coastal commission shall complete a final study of potential offshore sites and types of terminals for such sites. Such study shall indicate the most appropriate offshore terminal site or sites, in the coastal commission's judgement, together with the most appropriate type or types of terminals for each site.
>
> The results of such study shall be transmitted to the commission, the energy commission, to the Governor, and to each house of the legislature."[7]

The legislature asked the Coastal Commission to conduct this study under the policies and objectives of the California Coastal Act so that the resources along the California coast could be protected to the maximum extent, while at the same time determining offshore LNG site/terminal combinations that would be feasible, safe, and would provide for the reliable importation of LNG. Scenic and visible resources are protected by the Coastal Act and therefore were taken into consideration in the site and facility selection for this study. Section 30251 of the California Coastal Act states in part:

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[5] Liquified Natural Gas Act Stats, 1977, Chap. 855, Page 2506 (effective Sept. 17, 1977).

[6] California Resources Code, Div. 20, Art. 6 (1976).

[7] Liquified Natural Gas Act Stats, 1977, Chap. 855, Page 2506 (effective Sept. 19, 1977).

> The scenic and visual qualities of coastal areas shall be considered and protected as a resource of public importance. Permitted development shall be sited and designated to protect views to and along the ocean and scenic coastal areas, to minimize the alteration of natural land forms, to be visually compatible with the character of surrounding areas, and, where feasible, to restore and enhance visual quality in visually degraded areas.[8]

Implementation of the visual and scenic policies contained in the act posed a problem because of the high degree of subjectivity involved in assessment of this type of resource. Application of traditional planning techniques for scenic resource protection in a study of conceptual offshore LNG terminals proved to be a difficult task. What the California Coastal Commission staff needed to know from this study was what these facilities would look like at the sites being studied. The visual simulation technique provided an excellent tool for determining how these facilities might impact visual resources along the coast.

STUDY APPROACH

The Commission contracted with three designer-builder engineering firms to develop conceptual designs for one floating and two sea bottom-supported offshore LNG terminals at specific sites off California's coast. These designs permitted credible conceptual engineering and environmental evaluations of specific terminal types on potential offshore sites. At the same time, staff and consultants screened the entire California offshore area for zones where it might be feasible to site a terminal because of favorable winds, waves, water depths, and other factors. Seven zones off Southern California survived this initial screening; however, four were eventually recommended as acceptable (fig. 2). The zones have been evaluated with respect to terminal engineering problems, operational reliability in delivering gas to California, public safety, and adverse impacts on marine and coastal resources. Additional screening factors included conflicts with existing recreational, military and other uses of offshore areas, as well as terminal system cost, problems obtaining approvals, and starting terminal operation.

The evaluation of visual and scenic resources was broken up into three study elements which included 1) the number of people exposed to a particular scene, 2) the percentage of time the activity was visible due to atmospheric conditions, and 3) the compatibility of the activity with the surrounding viewshed. For estimating the number of people viewing the activity several methods were used. Cal Trans provided the staff with highway use figures for the coastal routes where some of the sites would be visible. In addition, the density of residential development in coastal areas was taken into account in determining the num-

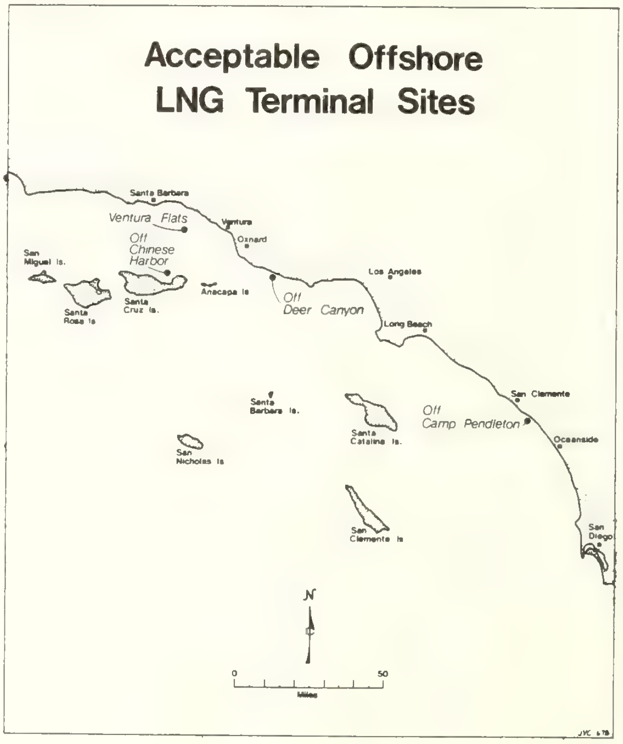

Figure 2--Acceptable Offshore LNG Terminal Sites

bers of people viewing a particular site. For the more remote sites such as the Channel Island related sites, figures were much more difficult to determine. The National Park Service provided some use figures for the Anacapa Island national monument, but very little information was available on visitation to Santa Cruz Island or Santa Rosa Island. In this instance we assumed that the number of people viewing the potential island related sites would be drastically less than the number viewing the sites visible from the mainland coast.

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[8] California Resources Code, Div. 20, Art. 6, S. 30251 (1976).

The second evaluation category dealt with the degree of visibility of the potential site zones from the areas where they might be viewed. Data on visibility were provided by J. J. McMullen Associates, Inc. (1978) who were maritime consultants to the Commission on the study. They provided the staff with figures on the percentage of time that the sites off the mainland coast would not be visible due to offshore atmospheric conditions such as fog and coastal haze.

Lastly, the overall visual compatibility of a facility with the surrounding area was an important factor in our analysis. For example, the Ventura Flats site (fig. 3) is located in an area that has 10 oil development platforms inshore of it, whereas the island related sites (fig. 4) are in an area with no existing industrial development. The data compiled in these three study elements provided the basis for the decisions made regarding visual resource values of the sites.

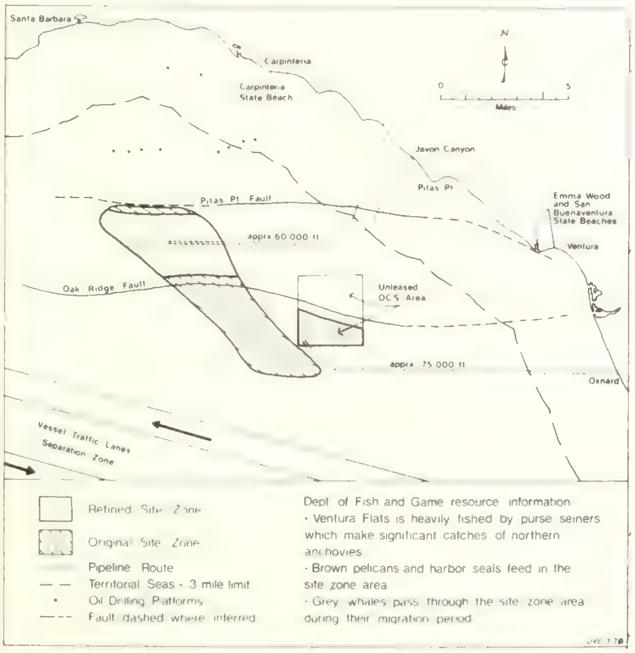
Santa Barbara
Carpinteria
Carpinteria State Beach
N
0
5
Miles
Javon Canyon
Pitas Pt
Emma Wood and San Buenaventura State Beaches
Ventura
Pitas Pt Fault
appr‹ 60 000 ft
Oak Ridge Fault
Unleased OCS Area
appr‹ 75 000 ft
Oxnard
Vessel Traffic Lanes
Separation Zone
Refined Site Zone
Original Site Zone
Pipeline Route
Territorial Seas - 3 mile limit
Oil Drilling Platforms
Fault dashed where inferred
Dept of Fish and Game resource information
· Ventura Flats is heavily fished by purse seiners which make significant catches of northern anchovies
· Brown pelicans and harbor seals feed in the site zone area
· Grey whales pass through the site zone area during their migration period
JVC 7 78

Figure 3--Ventura Flats

Even though the California Coastal Commission was collecting information mentioned above, some staff members felt that more was needed to evaluate fully the visual impact of the facilities at the site zones being studied. The design drawings of the facilities provided the information needed for the technical studies, but it was still difficult to imagine the visual impact of a terminal located at the proposed sites. A staff member contacted the Forest Service Pacific Southwest Forest and Range Experiment Station regarding the work that they were doing in coordination with the Department of Landscape Architecture at the University of California, Berkeley in the field of visual portrayal studies. We discussed the possibility of actually drawing the facility directly on the photographs at the proper scale, so that the visual impact of the facilites could be fully understood. The authors all agreed that this would be a useful and unique study in which to apply this concept.

In order to represent the facility at the proper scale at the proposed sites, the artist had to be provided with specific information regarding the location and angle from which the photographs were taken, location and dimensions of objects within the photographs, and dimensions of the facilities being represented on the photographs. Some of the photographs used for the renderings were not taken for this study and it was often difficult to determine exactly where the photographer was when the pictures were taken. Because of this, some of the locations had to be extrapolated from landforms located within the field of vision covered by the photograph. Original photographs should have been taken for all the renderings, but unfortunately the visibility in the Santa Barbara Channel was quite poor during this portion of the study, so photographs of that area could not be taken. Original photographs were used, however, for the Camp Pendleton offshore site rendering. The photographer took 36 pictures for the Camp Pendleton site, numbered them, and plotted their locations on a map of the area. This careful logging was extremely helpful for facility location purposes and scaling. In addition, certain objects in the photographs such as oil platforms, oil platform workboats, and offshore islands were used for scaling by the artist. The artist was provided with navigation maps showing the exact location of the sites being studied so he could represent the loca-

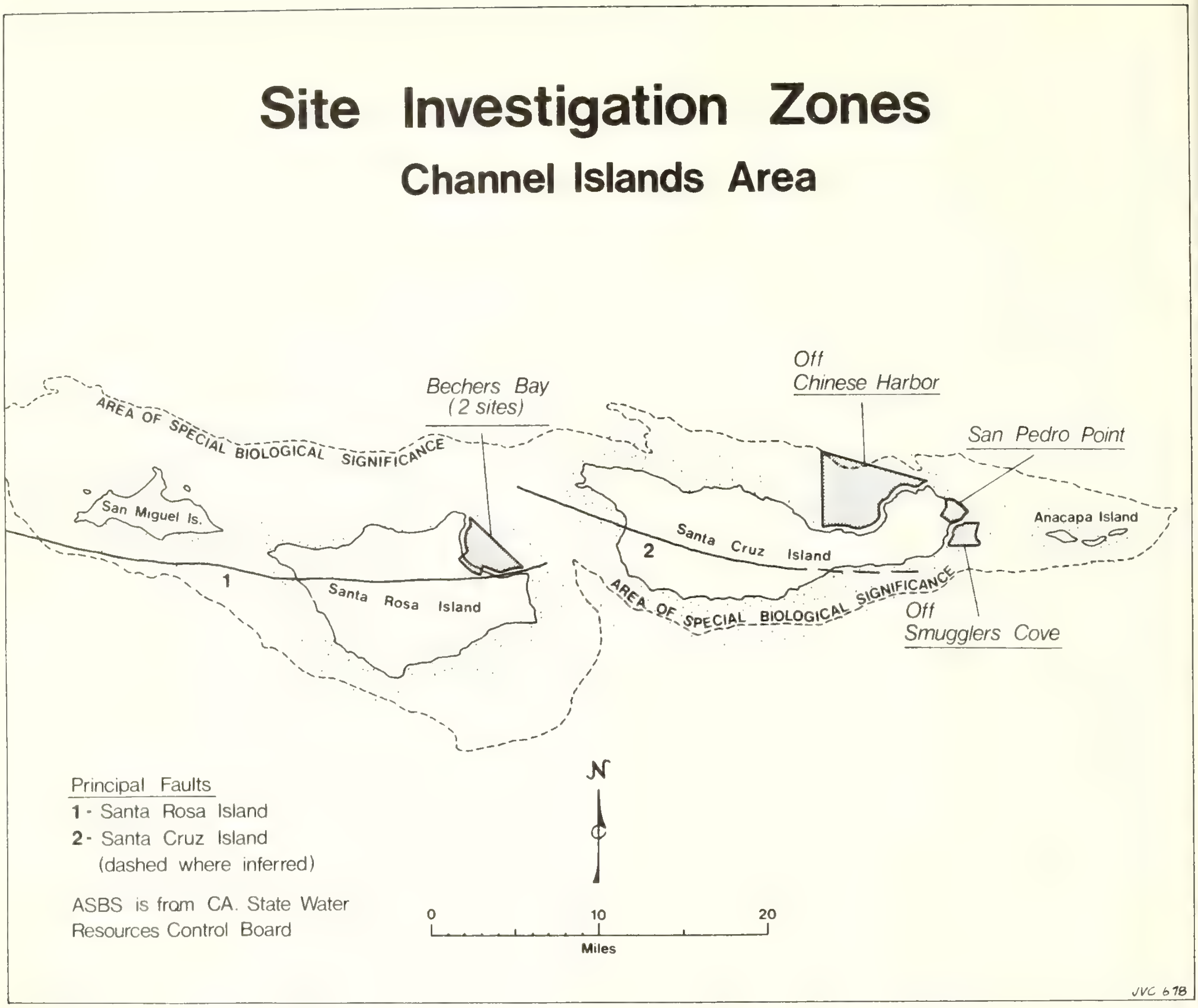

Figure 4--Site Investigation Zones Channel Islands Area

tion of the facility as accurately as possible on the photograph. Only after the artist was given all the above information and materials could he portray a terminal in a manner that would accurately represent the size and position it would assume at the potential sites being considered.

Application and Use of the Visual Portrayals

Proposed activities were rendered onto photographs of existing unaltered sites. Data on proposed dimensions, materials, colors, etc. were obtained from plans, elevations, and photographs of models. The form and outline of the proposed activity were drawn on a mylar overlay of a 7" x 10" print by conventional perspective drawing techniques (Martin 1968). These require that the observation point used in the photograph, and the site of the proposed activity be located on a topographic map or plan of the area. The eye-level or horizon line of the photograph must also be known or deduced from objects in the photograph. Detailed field notes on these and other elements, obtained at the time the photograph was taken, would obviate the need for corroborative field trips or guesswork where recognizable or measureable objects are absent from the field of view. For this reason, views containing features which can be readily located on the map or are of known dimensions are most helpful in checking that the scale and position of the activity in the scene are correct.

The completed outline of the activity was tranferred from the overlay to the print by tracing or through the use of paper frisket as a stencil. Retouch colors and opaque water-colors were then applied to simulate the colors and textures of the proposed activity. At this stage, decisions need to be made on such things as light conditions and shadow patterns. Any associated visual effects, such as water disturbance, smoke plumes, aerial perspective, or other man-made developments, must also be predicted, even though the design data are invariably too general to provide such information. Once completed, the altered print and its unaltered counterpart were rephotographed.

The technical feasibility studies performed by each terminal design contractor for the Coastal Commission were tailored to an illustrative site, to demonstrate in a site specific instance that that terminal feasibility could be achieved. Information obtained regarding strengths and weaknesses of the designs was then applied to the other site areas being anlayzed by Commission staff and consultants. The floating LNG terminal feasibility study was done for the Smugglers Cove site off Santa Cruz Island (fig. 4, 5), the deep bottom supported facility at Ventura Flats off Ventura County (fig. 3, 6) and the shallow bottom supported facility at the site offshore Camp Pendleton (fig. 7, 8). To parallel the studies being done by the design contractors, renderings of the facilities were done for each of the illustrative sites (figure 9*). Unfortunately, time problems encountered by both the Coastal Commission staff and the Department of Landscape Architecture study staff precluded doing a rendering for the shallow bottom supported facility. However, this facility did not turn out to be one of the favored facility designs anyway, so a rendering was not essential. The floating facility was the preferred design of the three, so the staff felt that renderings of this terminal should be done for as many of the sites as possible.

Slides were made of the rendered and original prints, showing the sites with and without the facilities for comparison purposes. These slides served three main functions for the Commission during and after the study. They aided the staff in policy decisionmaking; they were used in presenta-

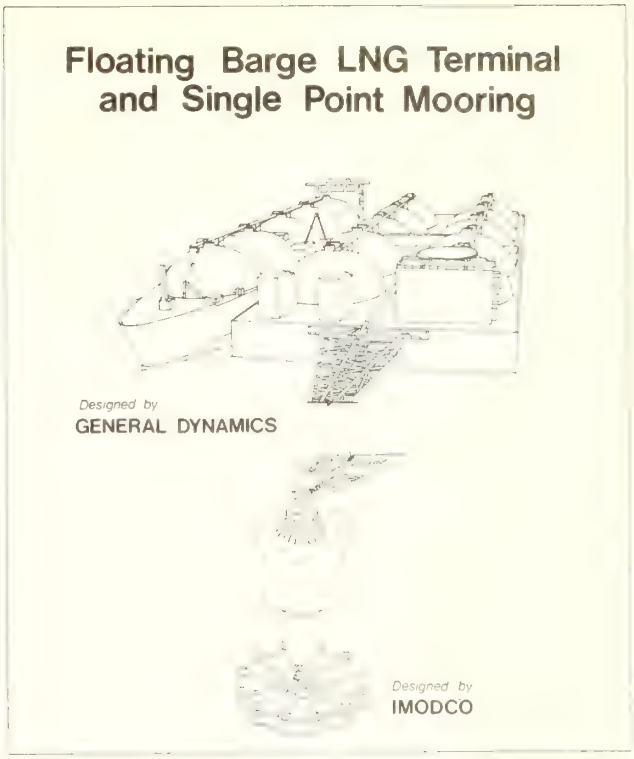
Floating Barge LNG Terminal and Single Point Mooring
Designed by
GENERAL DYNAMICS
Designed by
IMODCO

Figure 5--Floating Barge LNG Terminal and Single Point Mooring

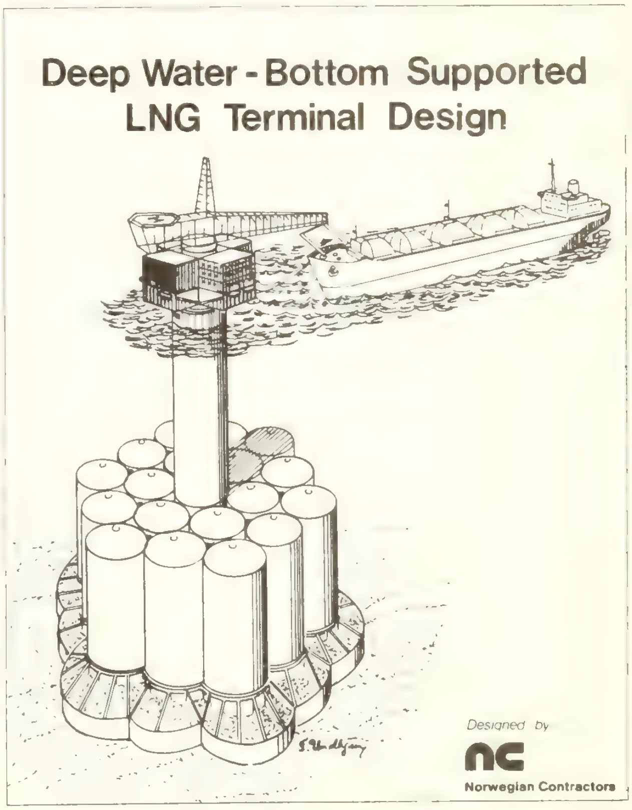
Deep Water - Bottom Supported LNG Terminal Design
Designed by
nc
Norwegian Contractors

Figure 6--Deep Water-Bottom Supported LNG Terminal Design

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*See color illustration on page 398.

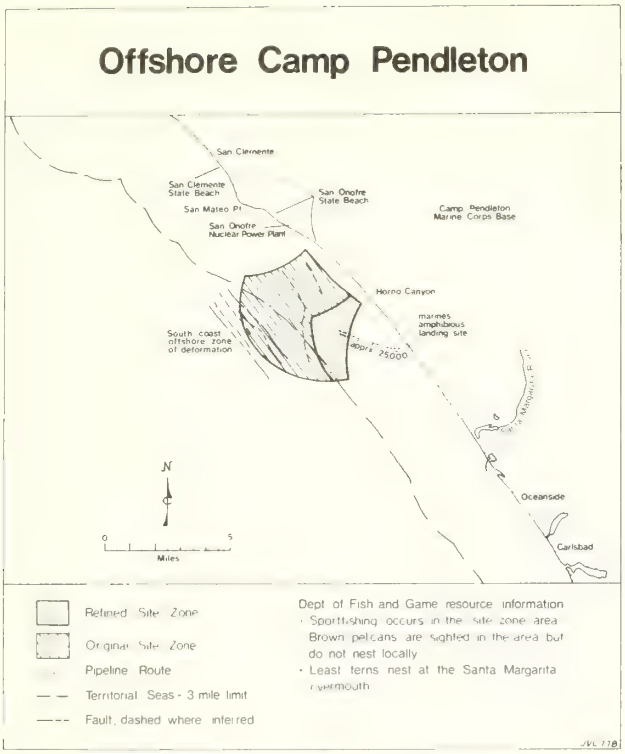
Offshore Camp Pendleton
San Clemente
San Clemente State Beach
San Mateo Pt
San Onofre State Beach
San Onofre Nuclear Power Plant
Camp Pendleton Marine Corps Base
Horno Canyon
marines amphibious landing site
South coast offshore zone of deformation
appr 25000
Santa Margarita R
Oceanside
Carlsbad
N
0
5
Miles
Refined Site Zone
Original Site Zone
Pipeline Route
Territorial Seas - 3 mile limit
Fault, dashed where inferred
Dept of Fish and Game resource information
· Sportfishing occurs in the site zone area Brown pelicans are sighted in the area but do not nest locally
· Least terns nest at the Santa Margarita rivermouth
JVL 778

Figure 7--Offshore Camp Pendelton

tions to the Coastal Commissioners to explain the differences in site/facility relationships and they were used to inform the public at workshops held in the affected counties. Showing the renderings of the facilities at the sites being studied greatly enhanced familiarity with contemplated LNG activity for those attending the presentations mentioned above, as well as demonstrating the magnitude of the terminals and their overall compatibility with their surroundings.

This method of demonstration was extremely useful in attempting to carry out the visual and scenic policies of the California Coastal Act. Speaking from a regulatory standpoint, protection of visual and scenic resources is difficult because of the subjectivity involved. Unfortunately, protection of these resources often receives little weight in regulatory actions, environmental assessments, or facility siting studies. The renderings helped Commission staff to compare the sites located off the mainland coast with the island related sites, and to emphasize what was already known about the visual impact of locating a terminal at the proposed sites. Commission staff knew the visual disruption of a facility near the islands would be the most severe, however, the staff also knew that very few people would be exposed to this view. On the other hand Commission staff were amazed at the relative visual compatibility the facilities had with the surrounding viewshed at the Ventura site (See figure 9*). This was due primarily to the existing oil development platforms in the vicinity of the site. The Ventura Flats rendering provided an important input in the recommendation of that site as the most appropriate offshore LNG terminal location. It provided a visual demonstration of Coastal Act policies calling for consolidation of development. Section 30250 of the California Coastal Act states in part:

> New development, except as otherwise provided in this division, shall be located within, contiguous with, or in close proximity to, existing developed areas able to accommodate it ...[9]

Additional support can be found in the following sections of the Act. Section 30260 states in part:

> Coastal Dependent industrial facilities shall be encouraged to locate or expand within existing sites and shall be permitted reasonable long term growth where consistent with this provision ...[10]

Section 30262 (b) gives additional support in the context of oil and gas development. It states:

> Oil and gas development shall be permitted in accordance with Section 30260, if the following conditions are met:
>
> (b) New or expanded facilities related to such development are consolidated, to the maximum extent feasible and legally permissible, unless consolidation will have adverse environmental consequences and will not significantly reduce the number of producing wells, support facilities, or sites required to produce the reservoir economically and with minimal environmental impacts.[11]

OBSERVATIONS

The primary reaction of most people viewing the renderings was surprise at the

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[9] Ibid., S. 30250 (1976).

[10] Ibid., S. 30260 (1976).

[11] Ibid., S. 30262 (1976).

*See color illustration on page 398.

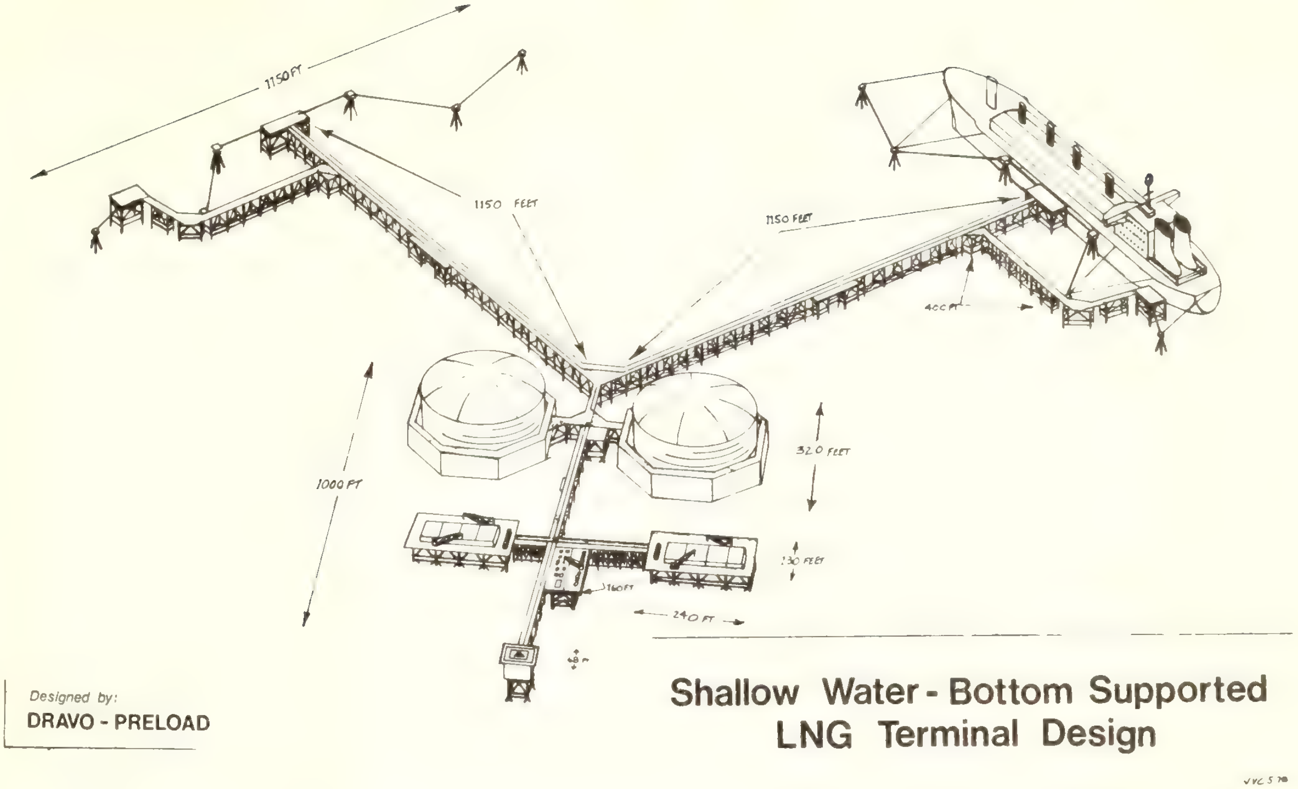

Figure 8--Shallow Water-Bottom Supported LNG Terminal Design

magnitude of the terminals. This was especially true at the Smugglers Cove site where the floating facility was represented in a more confined setting within a protected island cove. However, in a relative sense the terminals represented at Ventura Flats generated less of a reaction in terms of the size and intrusion of the facilities on the scene. Oil development platforms are located between the facility and the viewer at this site. Because of this, the facility seems more compatible with the surrounding viewshed. The relative compatibility of the Ventura Flats site/facility combinations as demonstrated by the rendering, provided one of the factors in choosing this as the preferred site. Not only was it compatible from a planning standpoint of consolidation of industrial development, but it definitely appeared to be less visually disrupting than the other site/facility combinations studied.

CONCLUSIONS

This technique provided the Coastal Commission with an excellent aid to combine evaluation of visual and scenic resources with the coastal protection policies of the California Coastal Act. The Act contains strong policies protecting visual resources, but these policies are useless if the resource cannot be assessed in some manner (Smardon and Hoke-Nunez 1976). The renderings helped Commission staff to refine further concepts about the visual acceptability of the facilities at the sites under consideration. In addition they provided an excellent device for demonstration of proposed staff findings which recommended a floating facility at the Ventura Flats as the most appropriate site/facility combination. The use of the visual portrayal technique should provide a valuable tool to energy facility siting studies being conducted in the future.

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Visual Impact Assessment in British Oil and Gas Developments[1]

Dennis F. Gillespie[2/]

Brian D. Clark[3/]

Abstract: Development of oil and gas resources in the North Sea has led to the application of visual impact assessment techniques to onshore oil and gas developments in the United Kingdom. Formal visual impact assessment methods are needed to supplement landscape evaluations and site selection studies. Three major orientations of British visual impact assessments are: the delineation and mapping of the zone of visual influence, or viewshed; the preparation of accurate graphic representations of the proposed facility; and, the collaboration of engineering and design professionals in all phases of facility planning and design. Visual impact assessments have been successfully applied in case studies throughout the United Kingdom. Formal methods and techniques for visual impact assessment will continue to evolve and their application will extend beyond oil and gas developments to include major energy and other industrial facilities.

INTRODUCTION

Visual resource management has a long established tradition in the United Kingdom. Since the Town and Country Planning Act of 1947 and the National Parks and Access to the Countryside Act of 1949, landscape management for amenity has been a statutory requirement (Hall 1975).

More recently, the Countryside (Scotland) Act 1967 and the Countryside Act 1968 require every, "Minister, government department and public body to have regard to the desirability of conserving the natural beauty and amenity of the countryside in all their functions related to land" (Cullingworth 1976). Consequently, the preservation of amenity is a basic objective of all planning policy. However, nowhere in the acts or their accompanying legislation is the term "environmental impact assessment" used, nor is there a statutory requirement for impact assessment as there is in the U.S.A., under the National Environmental Policy Act. Rather, local and regional planning authorities have considerable power to require, on a case by case basis, evidence that a proposed development will not injuriously affect the environment. With few exceptions, all development requires the prior approval of the local planning authority, and the authority has almost unlimited discretion as to what documentation will be required before planning approval will be granted. This is known as the "Development Control Process" and many planning professionals argue that it is sufficient, and a separate, formal environmental impact assessment process is not necessary. Others, including Thorburn

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[1/] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2/] Visiting Research Fellow, University of Aberdeen, Scotland, and Frank Knox Memorial Fellow 1978-79, Graduate School of Design, Harvard University, Cambridge, Massachusetts.

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(1978) argue that the development control process can only be improved by incorporation of some form of environmental impact assessment.

In the last few years increasing concern has been expressed about the effects of new large scale development on the quality of the environment and the ability of the planning and development control process to take these effects into account. Since 1970, the offshore discovery and development of oil and gas resources in the North Sea has placed tremendous pressures onshore, particularly in Scotland, for development sites for associated industrial facilities. This situation prompted the central government to examine the possibility of incorporating into the planning system formal methods and techniques of environmental impact assessment, including visual impact assessment.[4]

Since October 1973 the Project Appraisal for Development Control (PADC) Research Unit at the University of Aberdeen has been studying the methods and techniques of impact assessment used in the United Kingdom and abroad, with particular emphasis to their application in appraisal of oil and gas related development. Drawing upon the PADC work, this paper presents a survey of techniques for visual impact assessment applied to onshore oil and gas developments in the United Kingdom. It discusses both general approaches used in visual impact assessment and techniques used in specific projects.

NEED FOR VISUAL IMPACT ASSESSMENT

Landscape Evaluation

Prior to the discovery of North Sea oil and gas the approach planning authorities used to protect and manage the visual resources of the countryside was the preparation of a county or regional landscape evaluation. The evaluation was intended to classify the study area into homogeneous tracts or zones according to its relative visual quality. The particular high quality tracts identified would then be designated for conservation purposes on the local development plan and any incompatible development proposals would be excluded.

Sometimes recognized experts were commissioned and asked for a landscape evaluation based on their professional opinion.[5] Often planning officers and consultants developed formal methods of landscape evaluation and applied them in comprehensive county and regional studies. Among the best known work is that of Fines (1968), and of Land Use Consultants (1971), but numerous methods have been developed, applied and reviewed.[6] While certain methods were criticized,[7] most were generally accepted as legitimate and lands were subsequently designated for conservation.

Site Selection

Landscape evaluations are successful in rural environments where development pressure is low, several alternate development areas are available and the type of development is small scale land uses, already present in the area. With the increase in pressure for large scale industrial developments in the rural countryside and along the coastline, the traditional landscape evaluation begins to lose its effectiveness as a method of restricting development. Industrial site selection choices often extend well beyond county or regional boundaries. For certain facilities there may be literally only a handful of sites within a large region that can accommodate the installation for engineering or safety considerations. Site selection may also be influenced by government policy restricting certain developments from vast areas and encouraging there location in others. The Scottish Development Department (1974) identified certain segments of the Scottish coastline where oil and gas related industries are to be discouraged. The identification of the coastal segments to be conserved was based mainly on their "scenic quality" as judged through a series of landscape evaluations.

In other cases, a political decision may be made to locate within a certain region for employment and other social and economic considerations, or, the argument may be made that a particular facility site is the only suitable location and is necessary in the national interest, regardless of the immediate impacts on local amenity. Such an argument was advanced when planning approval was requested to develop a concrete offshore production platform fabrication yard at Drumbuie, near the mouth of Loch Carron on the west coast of Scotland (Baldwin and Baldwin 1975). The application was finally denied, but only after the Secretary of State for Scotland conducted one of the most extensive public inquiries on a development issue to that date.

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[4] Two major central government funded research reports resulted, see Catlow and Thirlwall (1977), and Clark _et al_. (1976a).

[5] See for example Murray (1962).

[6] See for example Robinson, _et al_. (1976), Dunn (1974), and Clark _et al_. (1976b).

[7] See for example Brancher (1969).

In situations such as these, the role of the landscape evaluation is to guide forward planning by identifying suitable sites based on amenity concerns. To be effective, they must inevitably precede site selection. Once a site has been chosen, comprehensive visual impact assessments during detailed project appraisal become a significant factor in deciding whether development should proceed.

VISUAL IMPACT ASESSMENT

Visual impact assessment to date in Britain has exhibited three major orientations. The first is the delineation of the "Zone of Visual Influence," or what is commonly referred to in the United States as the "viewshed." That is, a zone of adjacent land from which the proposed facility will be visible is mapped.

Second, it has been the concern for preparing an accurate graphic representation of what the facility will look like from certain sensitive viewpoints. While the emphasis is placed on the form of the facility and its general outline within the scene, certain studies have emphasized alterations in both the architectural design of the structures and the overall site layout.

The third, and perhaps most significant, orientation has been the active incorporation of architectural and landscape architectural designers into the initial facility layout and structural design stages of project development. Fortunately, a situation has resulted where impact assessment can easily stimulate design changes and mitigation measures that will ameliorate much of the negative visual impact.

Zone of Visual Influence

Several methods for determining the attendant zone of visual influence of a facility have been employed. They vary from rather simple techniques for study of small scale topographic maps, to computer simulations and to actual empirical data collection. In common with all is the desire to map the actual lands from which the facility will be visible.

The PADC Research Unit at the University of Aberdeen has suggested a simple technique for determining the zone of visual influence directly from topographic maps (Clark et. al. 1976b). First developed by Hebblethwaite (1973) for use by the Central Electricity Generating Board, the technique considers two factors, topography and horizontal distance from the installation. It does not easily allow for consideration of existing vegetation or structures although the technique can be adapted to include them.

Two inexpensive pieces of equipment are required, a transparent ruled "height plate," corresponding to elevation, and a transparent "sight line," (Clark 1976b). The technique involves laying the sight line over a large scale topographic map projecting away from the facility in any desired viewing direction. The height plate is superimposed over the sight line corresponding to the maximum height of the facility. Proceeding outward from the facility, visible and invisible points along the sight line can be identified. If the visibility of only one viewpoint along each sight line is important, it can quickly be determined.

This technique can provide a rapid and accurate method of determining if a proposed installation will be visible from a few specified sensitive viewpoints without the necessity of drawing elevation profiles. If the technique is used with successive sight lines established at constant intervals in all directions, an isopleth can be drawn around the installation defining the aerial extent of the zone of visual influence. The technique is of particular value to local planning authorities without professional staff skilled in either the drafting of elevation profiles or conducting computer-aided analyses.

British Gas Corporation prepares a viewshed analysis mapping all visible lands within a five-mile radius of most above ground facilities and for a larger radius from certain major installations.[8/] In the case of relatively small facilities, such as compressor stations along gas transmission pipelines, the viewshed may be determined from Ordinance Survey topographic maps using simple map study techniques such as those described above, or by preparing hand drawn elevation profiles at five degree intervals around the facility. For particularly

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[8/] Conversation with P.G. Parkinson, Environmental Planning Division of British Gas Corporation, 21 December 1978.

sensitive areas, hand drawn profiles are prepared at one degree intervals.[9]

For large industrial installations such as the St. Fergus coastal gas terminal and for liquified natural gas (LNG) storage installations, computer programs have been developed to determine the viewshed zone. The programs employ radial searching algorithms incorporating gridded input data on topography, vegetation and distance from a specified location, and outputs line printer or pen plotter maps. The programs are similar in operation to viewshed mapping programs described by Elsner (1971) and by Steinitz (1976).

The computer programs have been beneficial during early facility design stages to test rapidly the effects of changing site layouts, structure heights and potential landscape mitigation measures. The same technique has also been used for locating sites for radio masts which have to be within sight of each other (Dean and Graham 1976).

In cases where the facility was expected to be visible from a large area and the issue of visibility was of major importance, a computer viewshed map study has been supplemented with a different type of simulation. British Gas has raised balloons in the exact location and to the same height as the proposed structure, and then traversed the roads of the study area recording where the balloon can and cannot be seen.[10]

These techniques for determining the zone of visual influence yield information only on the extent to which proposed facilities will be visible. For a determination of how the facility will be perceived other analyses must be made.

Graphic Representations of Views

Almost all oil and gas project appraisals have included a graphic representation of what the installation will look like from one or more viewpoints. They usually represent a ground level view from a sensitive viewpoint several miles away in a nearby town or from a nearby public road. Typical of most such studies is that carried out for the Ross and Cromarty County Council in 1974 on a proposed oil refinery at Nigg Point at the mouth of the Cromarty Firth.

Cromarty Petroleum Co. Ltd. had applied for planning permission to use a 569-acre site on the southwest side of Nigg Point for construction of a very large crude carrier (VLCC) tanker berthing facility and a hydroskimming refinery with ultimate processing capacity of 200,000 barrels per day (Cremer and Warner 1974). If built, it would be the first refinery and among the largest industries in the Scottish Highlands.

The Architects Design Group (1974) was commissioned to analyze and comment on the visual impact of the proposal and the effects upon the amenity of the area. Nine sensitive viewpoints were identified and sight lines were constructed from the viewpoints, through the highest point of the proposed refinery facilities, to the hill serving as the backdrop to the site. The main emphasis of the analysis was to determine from which viewpoints the existing skyline of the hill would be broken by the refinery facilities. Sketches were presented showing the form of the facilities as they would be viewed from each viewpoint. An alternate site layout plan was proposed that would minimize skyline interruption from all nine viewpoints. The study did not indicate how the nine viewpoints were selected or how many people were likely to see the facilities from each viewpoint. The proposal was subsequently withdrawn for reasons other than the expected visual impact.

A similar analysis was carried out for a proposed natural gas liquids separation and storage facility near Peterhead, Scotland (Shell U.K. Exploration and Production 1976). In this case, the facility was proposed in an agricultural area of gently rolling topography with numerous hedgerows and woodland copses. Altering the site layout or onsite planting of vegetation screening would have little effect on the visibility of the higher structures from distant viewpoints. Instead, limited offsite planting of vegetation along the sight lines, between the viewpoints and the facilities was proposed to act as a visual screen. Elevation profile drawings documenting the site line analyses and sketches of the view from each viewpoint with and without mitigative vegetation planting were presented.

With a large number of viewpoints from which a view of a facility must be represented, the preparation of hand-drawn elevation profiles and sketches can become an almost insuperable task. British Gas, working with the Computer Aided Design Centre of Cambridge, has developed a computer program for quickly and accurately simulating the addition of a structure or group of structures into a photograph of the landscape (Dean and Graham 1976).

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[9] Conversation with Frank Dean, Chief Environmental Planning Officer, British Gas Corporation, 21 December 1978.

[10] Conversation with P.G. Parkinson, Environmental Planning Division of British Gas Corporation, 21 December 1978.

The program uses as input: three-dimensional coordinate location information for existing objects within the photograph; information as to the viewpoint, height, lens focal length and enlargement factor of the camera used; and three-dimensional descriptive and locational information on the structures to be inserted into the photographic scene. The program calculates the position of the structure within the scene and plots, to scale, the structure outline on a transparent overlay as it would appear in the photograph. The technique is of value to British Gas because they are continually conducting such analyses and because the majority of their facilities are of standard design. Thus, the facility unit descriptions in computer readable form can be stored for continual use. The program allows for rapid evaluation of the effects of design alterations, site layout changes and topographic or vegetation changes. When the final site layout and facility design is selected, a photomontage can be prepared for public presentation.

The technique has been successfully used in a number of studies, especially for gas pipeline compressor stations.[11] The computer aided photomontage technique can be expected to play an increasing role in the visual impact analyses prepared by British Gas.[12]

Design Collaboration

When it is not possible to site a major facility out of view, emphasis has been placed on incorporating architects and landscape architects into the project engineering design team. Rather than bring designers into the process only to assess or attempt to mitigate visual impact, they have been incorporated from the initial stages of project design so that many potential impacts have been avoided in the first instance. Two of the earliest gas terminals to receive comprehensive design treatment were the Bacton terminal in Norfolk, and the Theddlethorpe terminal in Lincolnshire. In addition, the most recent attempts at professional collaboration have dealt with the main oil and gas receiving, storage and distribution terminals in Scotland. They are the St. Fergus gas terminal on the northeast coast near the town of Peterhead, and the Flotta crude oil terminal in the Orkney Islands. The Sullom Voe oil terminal in the Shetland Islands is the largest oil handling terminal in Britain and is operated by British Petroleum for a consortium of companies. Several studies including limited environmental impact assessments preceded construction (The Sullom Voe Environmental Advisory Group 1976). However, no comprehensive visual impact assessment or mitigation studies were prepared, apparently because of its isolation.

St. Fergus Gas Terminal-- From the time a site near Peterhead, on the northeast coast of Scotland, was selected for the major receiving and distribution system of gas from the Frigg offshore field, the Architects Design Group collaborated with British Gas engineers in all phases of the site layout and facility design.[13] The component buildings, compressor stations, piping units, gas storage tanks, pressure release stacks and all ancillary facilities received design treatment by the architects. The offshore pipeline landfall required excavation through and restoration of a frontal dune. Recently completed, the result is a sensitive, orderly, visually coherent example of an industrial facility that is usually perceived negatively.

Flotta Oil Terminal-- The major oil handling terminal in Scotland to receive detailed visual assessment is currently under construction on the island of Flotta, in the Orkney Islands off the northern coast of the Scottish mainland. Occidental Petroleum Corporation of Britain, in association with other companies, selected the Flotta site after evaluation of seven possible locations in Scotland (Thielhelm 1973). The comparative evaluation was made based solely on technical suitability for construction and operation of the terminal facilities with no consideration of visual or other social and environmental concerns. Occidental subsequently retained W.J. Cairns and Partners, an Edinburgh planning and design firm, to conduct detailed environmental analyses of the project, including a comprehensive visual impact analysis (Cairns and Associates 1974).

The Flotta study was concerned with the site layout and color treatment of the seven oil storage tanks, to minimize their visibilty as viewed from adjacent islands and from the air, and to "achieve maximum integration of the development and the landscape..." (Cairns and Associates 1974). Because Flotta was directly under a heavily travelled commercial airline flight path, the form of the terminal layout as perceived from a nearly plan view took on added significance.

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[11] See for example Architects Design Group (1978).

[12] Conversation with Frank Dean, Chief Environmental Planning Officer, British Gas Corp., 21 December 1978.

[13] Conversation with Frank Dean, Chief Environmental Planning Officer, British Gas Corp., 21 December 1978.

The study identified seven "cones of site visibility" within which the terminal would be visible to boaters in surrounding Scappa Flow and to motorists on public roads on the adjacent islands. Panoramic photographs were taken from representative viewpoints within each cone of visibility and from the air. Working with project engineers,alternative tank sizes, heights and layouts were sketched as they would be viewed from each viewpoint. Site models at the scales of 1:5000 and 1:1000 were also prepared. Each alternative model layout was photographed from sea level foreground, middleground and background positions. The three criteria against which each proposed layout was measured were, to minimize "edge definition," diminish "depth of field recognition," and maximize "visual overlap." Neither the alternative layout schemes nor assigned ratings based on the criteria are presented. Through successive iterations a final "solution" was agreed upon.

In attempting to design to meet the above criteria, the selection of tank color became an important factor in the Flotta study. The tanks would been seen against a backdrop of low rolling topography barren of trees and covered in various heathers, grasses and low shrubs, all changing color with the seasons and with atmospheric light conditions. Two alternative approaches to color treatment of the facilities were examined. The first was that of using bold primary colors in "image making." It is argued that in monotonous landscapes brightly colored structures can provide a sense of place and location, a landmark for orientation and a stimulus for visual excitement (Cairns and Associates 1974). The designers recognized that while such an approach has been successful when used in the nondescript urban industrial scene, the approach is not likely to be totally accepted in this location of comparatively undisturbed countryside. Thus, they adopted a strategy of using color to camouflage the tanks to the extent possible not to try to make the installation invisible, but to attempt to breakup the solid mass of the tanks and integrate them with landscape. The use of bold colors was not abandoned entirely, however. Working on the hypothesis that a single bright object in a field of homogenous dull objects will be visually isolated and will focus attention on itself and away from the remaining objects in the field, the designers proposed using bold, bright colors on the associated control, storage and maintenance complex.

In order to test the camouflaging effect of various colors, a technique described by Hardy (1971) was used to simulate the introduction of colored structures into a photographic landscape scene. Eleven colors from the British Standard 4800 range were selected for testing. Six landscape scenes representing the variation in vegetative landcover and background color were photographed and printed on high quality color enlargements. A rectangular strip of each of the eleven colors was then superimposed onto each of the six photographs, resulting in 66 superimposed photographs Each composite photo was then rephotographed onto transparent color slides. Each of the six sets of eleven colors were then evaluated on a scoring system applied independently by four trained observers in two groups. Potential colors were narrowed to two and submitted to onsite testing by erecting large color panels in the location of the tanks, photographing them on transparent color slides and repeating the rating process. Finally, a single color for each tank as viewed from each viewpoint was selected.

No justification is given as to why or how the original range of eleven colors were identified, nor what the evaluation criteria were or how they were applied in the rating. It also seems that the design team felt they must eventually narrow color selection to one or at most two colors for ease of application and maintenance.[14/] With the exception of these possible shortcomings, the Flotta study represents a significant attempt at collaboratin with petroleum industry engineers in assessing, and more importantly mitigating, visual impact of the proposed project.

British Gas has incorporated many of the same color and pattern concepts explored in the Flotta study into their treatment of gas transport and storage facilities, particularly gas pipeline compressor stations and liquified natural gas (LNG) storage facilities.

The national gas transmission system in Britain comprises over 3000 miles of onshore pipelines up to 36 inches in diameter (British Gas Corporation 1977a). Compressor stations are required approximately every 40 miles on a major truck line in order to maintain required pressures. A station may occupy from 20 to 40 total acres with from 5 to 10 acres of above ground structures. The compressor cab enclosure are the largest and most visible structures on any site. Recognizing that the compressor cabs should be visually pleasing as well as acoustically suitable, British Gas undertook a program beginning in 1969 where engineers, architects and compressor manufactures collaborated on the architectural design of compressor

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[14/] Conversation with W.J. Cairns, Senior Partner W.J. Cairns and Associates, 20 November 1978.

cabs (Dean and Graham 1977). Two standard designs resulted. Working with these standard units, site planners develop individual layout plans for each station.[15]

LNG storage installations represent greater visual intrusions in the landscape than do compressor stations. They are much larger in size and scale than compressor stations, and are often associated with other existing industry. Thus, opportunities for architectural modifications of the facilities are much more limited than in the case of compressor stations. British Gas has instead relied on color treatment as the primary visual impact mitigation technique for LNG storage installations.

LNG storage tanks are the major visual feature of any storage installation. The standard tanks used in Britain are approximately 150 feet (46 meters) high and 150 feet in diameter. A typical storage installation will include two or more such tanks along with associated structures and buildings. British Gas has adopted the approach that it is useless to attempt to camouflage the tanks, and instead attempts to use contrasting colors to integrate the tanks visibly with their surroundings. Rather than using singular striking colors to draw attention to the tanks in an "image-making" exercise as was considered in the case of the Flotta oil terminal, patterns of contrasting colors are developed for each specific situation to attempt to break up the mass of the tanks when viewed from sensitive viewpoints. Two existing LNG storage installations to receive such color treatment are at Glenmarvis in Scotland, and at Partington in Cheshire, England.

The installation at Glenmarvis includes two tanks with the possibility of a third future tank in a "greenfield site," an area with no existing industry. The site is an agricultural area on gently undulating topography and is equally visible for several miles in all directions. There are no topographic features to serve as a visual background. Thus, the tanks are viewed against the sky from throughout the viewshed.

A horizontal banding pattern of blue colors was developed to breakup the perceived verticality of the tanks and to attempt to give the impression that the tanks fade into the sky. The dark blue colors at the base of the tank visually anchor and associate it with the surrounding installation structures, while the progressively lighter blue colors moving up the tank are intended to merge the tank top with clouds in the background sky.

The LNG installation at Partington, Cheshire, is in a quite different situation. The three new tanks and associated structures are located within an existing industrial area and can be seen from three strikingly different viewpoints. From the west the tanks are viewed in the foreground from a residential area; from the east and southeast they are viewed in the middleground within an industrial panorama; and from the north they are viewed as background elements to an existing large petrochemical complex. The analysis examined several possible combinations of color and pattern for each of the three viewpoints recognizing that no single solution would be suitable for all three viewpoints.

Consequently, a scheme was selected involving painting the three sectors of each tank oriented toward each viewpoint with colors either to harmonize or contrast with the surrounding visual elements, as determined appropriate. A pattern of vertical stripes of varying widths was selected to reduce visually the square proportions of the tanks and to correspond to the other vertical industrial elements adjacent.

Four colors were selected, a deep violet, flat white, reflective aluminum and a yellow-orange. The violet and white combination is in the foreground from the housing area to the west and is intended to break up the massive silhouette of the tanks. The reflective properties of the aluminum colored stripes against the flat white stripes were intended to create light absorbing and reflecting "shimmer" effects when viewed from the southeast in the middleground panorama of the existing petrochemical complex. The predominately orange face of the tanks is intended to serve as a strong positive contrast to the dull monotone of the existing industrial complex, when viewed from the north as background elements to the existing petrochemical complex. The associated buildings and structures also receive architectural design and color treatment in order to link the tanks and associated structures visually as a single unified complex.

CONCLUSION

Concern for visual resources and their management has long been an objective of British countryside planning. However, increased pressure for industrial development in the countryside in recent years has forced the incorporation of visual impact assessment techniques into the development control process.

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[15] See for example British Gas Corp. (1977b).

So far these techniques have largely been limited to manual and automated viewshed analysis and graphic representations of what the proposed facility will look like from sensitive viewpoints. Recently, significant cases of professional collaboration between engineers and designers in the overall layout and architectural design of oil and gas installations have resulted. Of these three major orientations toward visual impact assessment, collaboration between engineers and designers appears to have been the most successful in mitigating visual impacts. When such collaboration also occurs in the regional site selection studies, overall reduction in the visual impacts of the eventual development is even more likely.

Formal methods and techniques for visual impact assessment will continue to evolve, and their application will extend beyond oil and gas developments to include major energy and other industrial facilities.

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A Technique for the Assessment of the Visual Impact of Nearshore Confined Dredged Materials and Other Built Islands[1]

Roy Mann[2]

Abstract: Drilling rigs, confined dredged material disposal sites power and sewage treatment facilities, and other built objects on or near shorelines have often created appreciable impacts on the aesthetic perceptions of residents and recreational users. Techniques for assessing such impacts that are reviewed in this paper include viewscape analysis for large-scale shore facilities, as employed in the Long Island Sound Regional Study and the visual impact analysis used in the Hart-Miller Islands Environmental Assessment for review of alternative spoil island location. Guidelines and design solutions reviewed include those developed for offshore rigs at Long Beach, California; for a free horizon arc offshore of Santa Rosa Island, Florida; and for landscape concepts for dredged material sites prepared for the U.S. Army Corps of Engineers.

INTRODUCTION

The confinement of dredged navigation channel sediments in diked disposal facilities is an important function of harbor and waterway development and maintenance, particularly where open water disposal and undiked mounding of dredged materials are prohibited or impractical.

Assessment of the visual impact of proposed disposal facilities is often a necessary step in facility planning, since facility appearance is typically intrusive and contrastive to natural shore landscapes, particularly where these are scenic or recreational, and may be incompatible aesthetically with urban civic or residential areas.[3]

In 1969 the Maryland General Assembly appropriated funds for the construction of a diked disposal area in upper Chesapeake Bay in the vicinity of Baltimore Harbor for the purpose of confining sediments dredged in the maintenance of existing Harbor channels and for the development of new channels or additional channel depth.

A site for the facility was selected by the Maryland Department of Natural Resources at Hart and Miller Islands, two small marshy islands situated approximately 1-2 miles offshore of the western Bay mainland. Design development of the diked facility, planned to contain 52.8 million cubic yards of dredged spoil was initiated in 1970. An environmental impact study was prepared by the U.S. Army Corps of Engineers in 1974. The Maryland Department of Natural Resources subsequently contracted with Roy Mann Associates in 1975 to conduct a peer review of outstanding environmental impact questions.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Roy Mann, President, Roy Mann Associates, Inc. Cambridge, Massachusetts.

[3] Harrison, Joan and Laurie C. Chisholm. Identification of Objectionable Environmental Conditions and Issues Associated with Confined Disposal Areas. Arthur D. Little, Inc., prepared for Environmental Effects Laboratory, U.S Army Corps of Engineers. Sept. 1974.

In the execution of the Peer Review[4], RMA identified and analyzed various potential environmental impacts, including visual impacts, at the Hart-Miller Islands site and at nine alternative sites in upper Chesapeake Bay or Baltimore Harbor.

The following discussion summarizes the methodology developed by RMA for evaluation and comparison of the visual impact of the alternative sites vis-a-vis the proposed spoil facility.[5]

Project Description

The Hart-Miller Islands disposal facility planned for a 52.8 million cubic yard capacity within an area above mean sea level of 1012 acres. A perimeter dike, the element most readily visible to observers at or near sea level, would crest at 18 feet above sea level and would be armored with rip-rap on its exposed Bay sides. The new island would measure 2 miles by somewhat less than 1 mile at its Hart-Miller Islands location, but would take other configurations at the alternative sites, reflecting benthographic, navigational, and other conditions unique to each of these locations.

Assumptions

The probable visual impact of a dredged materials disposal facility may be estimated through delineation of viewing zones, identification of the size of presumably sensitive viewing populations, description of visual characteristics of the proposed facility, identification and analysis of adverse characteristics of the facility, and evaluation of facility visual impact on foreground and background landscape. Weighting factors may include the degree of contrast between the proposed facility and the existing site environment and the degree to which impact mitigation measures offer assurance that negative impact can be minimized and positive impact made possible.

Earth Curvature

For observers in boats or others at or close to sea level, the earth's curvature and light refraction by haze covering Bay waters may combine to obscure the lower portion of the dike. A boater with eye level at 6 feet above the water line would be able to see the uppermost 9 feet of a facility dike at a distance of three miles. Any elevation less than 9 feet (half the dike height) would seem to lack visual significance. However, since some sport fishermen, cruising boaters, and excursion boaters may be at an eye level 8 to 12 feet above water level, five miles was judged to be maximum distance from the facility dike site within which visual impact would have significance for boaters and other observers across the open Bay.

Distraction Zone

Other factors, such as the obscuring of view by vegetation, waves, haze and smoke, and structures in the field of view may diminish the significance of the nominally visible portion of the facility or even the facility as a whole. The existence of minor elements, including vegetation, which filters but does not eliminate views of the facility, can constitute a distraction zone, that is, a stratum of the field of view in which interference renders neutral an otherwise visually significant object. The height of the zone (see fig. 1) can be subtracted from the bottom of the Bay image beyond to locate the minimum significant sight line correctly. This corrected field of view will allow the investigator to plot the true elevation below which views of the facility cannot be obtained. Where sufficient field knowledge of intermediate crest conditions was unobtainable, a 30-foot height was assumed for the distraction zone in vegetated areas, under Step 2, Visual Zone Delineation (see below).

Significant Viewable Surface

A diked disposal facility presents a great deal of perspective foreshortening to the observer where the incident angle of view is

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[4] Roy Mann Associates, Inc., Peer Review of the Evaluation of Hart and Miller Islands and Alternatives for Dredged Materials Disposal. Prepared for the State of Maryland Department of Natural Resources. July, 1975. See chapter 6: Visual Impact.

[5] Since the actual impact ratings of the alternative sites are not directly germane to the discussion of methodology presented here, they have been omitted from this paper. Interested readers may request a copy of either Chapter 6 or the full Peer Review from the Department of Natural Resources, Annapolis, Maryland.

FIGURE 1: VISIBILITY FACTORS, OPEN WATER

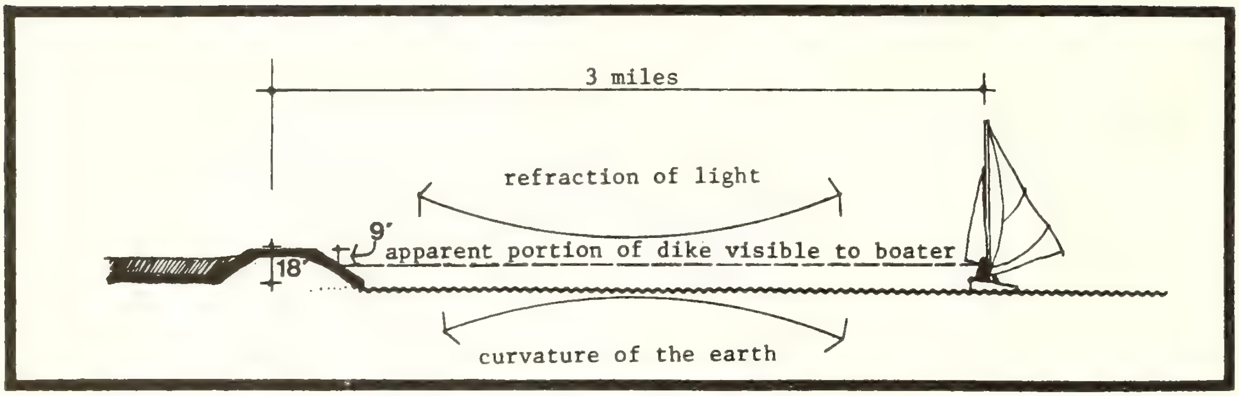
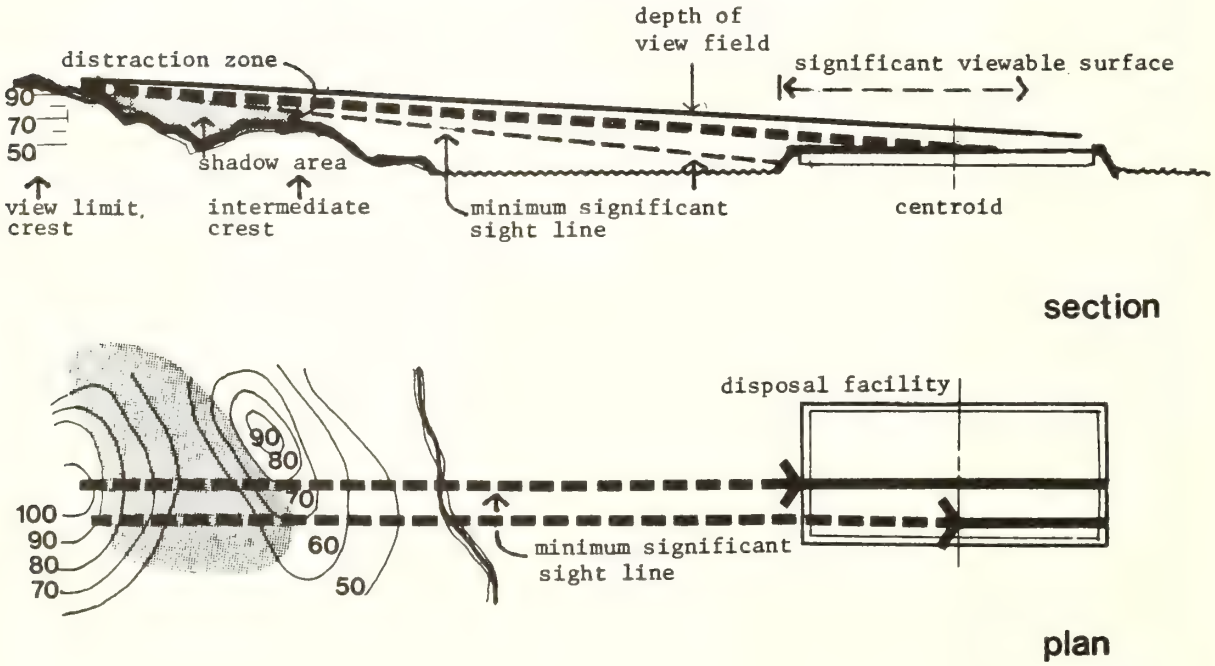


FIGURE 2: DISTANT OBJECT VISIBILITY



low. The dike itself may represent a major portion of the island's silhouette. The significant viewable surface can be considered the entire surface extending from the lowest significant sight line (see Figure 2) to the distant edge of the facility. However, where only the far edge of the facility (beyond its centroid) was visible to inland observer positions over the crest of intermediate hills, impact was considered insignificant and the observer positions were excluded from the impact zone.

Distance

Distances of 6 miles over land areas and 5 miles over water were taken as the far boundaries of viewing zones within which visual impact would be potentially significant. Although in some instances views of alternative sites could be obtained from the probable merging of facility silhouette with island and harbor forms in the Baltimore Harbor area over greater distances, the 6 mile limit was considered realistic.

METHODOLOGY

Step 1: Determination of the Impacting Aspect of the Facility Image

For the purpose of defining a single standard of evaluation against which each of the ten alternative sites and their physical configurations could be assessed, the significant viewable surface (see above and Figure 2) was taken as equivalent to the visually impacting aspect of the facility. The differentiation among sites would be left to the distinctions in viewing populations within the viewing zones.

Step 2: Delineation of Viewing Zones

Next, delineation of the viewing zone projectable from each alternative disposal site was undertaken. A viewing zone consisted of the water and terrestrial surface over which the 18-foot high dike structure (9-foot high bulkhead in inner harvor sites) and the disposal area to the rear would be visible.

The limit of the terrestrial viewing zone for each candidate facility was delineated through analysis of topographic maps and aerial photos, as follows:

- Sight lines were projected from the centroid of each alternative facility site to surrounding topography up to the highest point within a six mile radius. Shadow areas between crests or ridges, i.e., areas from which views of the facility could not be acquired, were eliminated from the viewing zone.
- The viewing zones were also reduced to reflect the distraction zones identifiable above intermediate crests. The height of the distraction zones were presumed to be 30 feet where tree masses existed and 10 feet where open fields predominated.
- The projection of sight lines was repeated at 30° intervals over 360 degrees.
- The viewing zones were further corrected to reflect restriction of view of the facility by intervening factories, bridges, viaducts, and other built structures.

Step 3: Determination of the Size of the Affected Viewing Population

The potentially sensitive viewing population within each delineated viewing zone was identified, in total numbers. Included were:

- residential population
- daily visitors to selected major activity centers related to park, recreational, educational, and civic-cultural use
- numbers of motorists using bridges from which a candidate facility could be viewed
- numbers of boaters estimated to use boats registered in the homeport of which the viewing zone is part

Weighting Factors: Since resident and institutional viewers are likely to experience most frequent visual contact with the numbers of users of the proposed facilities, greater weight was assigned to potential impact on this viewer group.

Method: 1970 U.S. Census tract data were analyzed in conjunction with land use maps and U.S.G.S. topoquads to determine the percentage of the population within each tract residing within the viewing zones and who therefore could be expected to come in visual contact with the proposed structure. Counts of potential viewers employed in industrial areas within the viewing zones were excluded from the analysis since many employees may also be residents within the same viewing zones and because construction of a disposal facility within an industrial visual setting was presumed not to modify existing visual quality substantially, either adversely or beneficially.

No attempt was made to estimate the percentage time viewing populations might actually view the facility, because a reliable method for such estimations has not yet been established by research in the field and because population size alone is an acceptable parameter for comparing impact among alternative sites. However, factors which would tend to increase likelihood of view, such as topography, openness of housing patterns, and orientation of residential city streets towards the facility sites, were employed as weighting considerations.

The results of the Step 3 analysis are shown in Table 1.

Step 4: Visual Quality Evaluations

The final step of the visual analysis involved evaluating the compatibility of the candidate facilities on the existing foreground and background visual environments of each site. Photographs taken from selected viewing orientations were utilized together with drafted constructions of the presumed facility overlaid on the photographic prints. Compatibility effect on visual quality were evaluated for four criteria:

- Obstruction of view: The degree to which construction of a proposed facility will obstruct open bay or cross water views.

- Compatibility with foreground: The degree to which the disposal facility will be

Table 1--AFFECTED VIEWING POPULATION*

	TOTAL RESIDENTIAL VIEWING POPULATION	SELECTED MAJOR ACTIVITY CENTERS	AVERAGE DAILY TRAFFIC[2/]	RECREATIONAL BOATERS[6/]
Hart-Miller	3,662	3,000[1/]		19,825
Black Marsh	4,192	--		19,825
Hawthorn Cove	4,779	--		16,779
Man O'War Shoals	5,511	--		10,183
Patapsco River Mouth	13,167	--	2,181,000[3/]	10,183
6-7-9 Foot Knolls	3,899	--	29,890[4/]	21,607
Belvidere Shoals	4,638	--	29,890[4/]	21,607
Sollers Point	3,425	--	2,181,000[3/]	10,183
Colgate Creek	1,725	--	2,181,000[3/]	10,183
Middle Branch	3,841	--	31,620[5/]	10,183

[1/] Maximum daily visitors; Rocky Point Park Source: RMA telephone communication with Rocky Point County Park manager.

[2/] Computed at 1.5 persons/vehicle

[3/] One lane traffic; new Outer Harbor Crossing Source: Table 21 Outer Harbor Bridge Estimated Traffic and Revenue 1976-1985; Maryland Dept. of Transportation.

[4/] One lane traffic; Lane Memorial Bridge Source: State of Maryland "Traffic Volume Map," 1974. RMA telephone communications with Bureau of Traffic Engineering, Md. Dept. of Transportation (June 1975).

[5/] One lane traffic; Hanover Street Bridge Source: same as above

[6/] Average no. of persons per boat = 2.82; includes water stored craft only Source: Recreational Boating in the Continental U.S. in 1973; Coast Guard, October 1974, pg.51.

* Source: Peer Review of the Evaluation of the Hart and Miller Islands and Alternatives

compatible with the form, color, texture, and scale of the foreground visual setting.

- Significance of view of the facility interior: The degree to which the interior of a facility is exposed to view from elevated observer positions.

For each of these criteria, a rating scale of -5 to +5 was used. A negative assessment for each criterion implies, respectively: greater obstruction of views, lower compatibility with the existing visual setting, whether foreground or background, and greater exposure to view of of the interior of the facility. Weighting factors included the presence of distracting elements in the visual setting of each site, which would tend to mask negative aspects of the facility, and the operating life of each facility during which construction and disposal activities and machinery would accentuate negative effects.

The results of the Step 4 visual quality analysis are displayed in Table 1. Obstruction of view and compatibility of the structure with existing foreground and background visual setting are considered the most important criteria in assessing visual impacts. Therefore, evaluations of these factors are summed in the fourth column total, to provide a first order indication of the relative expected visual impact for each candidate site. The other three factors: significance of view, presence of distracting elements, and facility operating life are utilized as weighting factors in conjunction with the magnitude of the affected viewing populations to derive a final assessment of overall visual impact.

FINDINGS

- As indicated in Tables 1 and 2, which are excerpted from the Hart-Miller Review findings, the visual zones of the alternative facility sites were characterizable in terms of viewing population sensitivity, and probable visual effect of the facility on foreground and background of the site.

- The differentiation among site impacts was distinct, reflecting primarily a variation in sizes of sensitive populations.

- Distraction zones and their influences on visual impact of distant large scale shore facilities are not easily defined and deserve further investigation.

- Earth curvature, sea surface characteristics, and atmospheric conditions may reduce the visual impact of low offshore and nearshore disposal facilities to observers on the water or at the water's edge, at distances great enough to create an apparent dimunition of silhouette. These factors, however, also deserve further investigation with respect to their mitigating effect on visual impact.

- Providing design modifications in the alignment and topographic character of perimeter dikes, combined with selective tree planting, may achieve mitigation of visual impact, where feasible. These mitigative measures were not provided for in the scope of the Hart-Miller Review, but are recommended for consideration in future impact analyses.

The Visual Management System of the Forest Service, USDA[1]

Warren R. Bacon 2/

Abstract: The National Forest Landscape Management Program began, as a formal program, at a Servicewide meeting in St. Louis in 1969 in response to growing agency and public concern for the visual resource. It is now an accepted part of National Forest management and is supported by a large and growing foundation of handbooks, research papers, and audio/visual programs. This paper is an abbreviated presentation on how the Visual Management System (VMS) functions.

INTRODUCTION

The American people are concerned about the quality of their visual environment. Because of this concern, it has become appropriate to establish the "visual landscape" as a basic resource, to be "treated as an essential part of and receive equal consideration with the other basic resources of the land" (FSM 2380). 3/ At the same time, public demand has increased for goods and services produced on much of the same land. It has thus become necessary both to inventory the visual resource and provide measurable standards for its management.

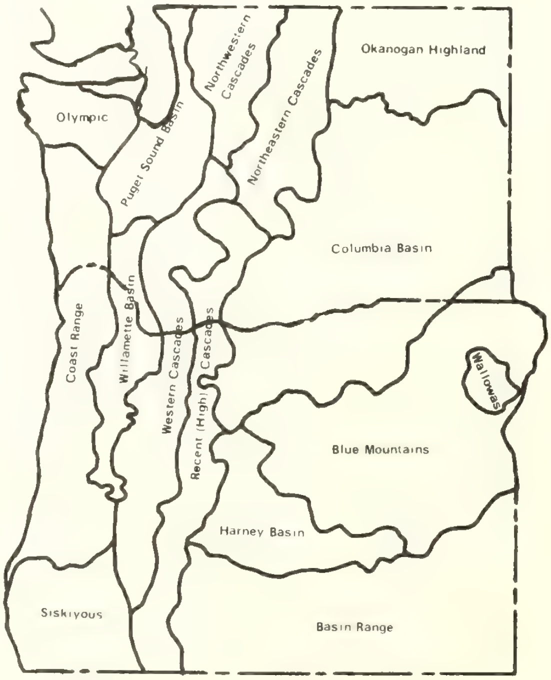
The Visual Management System provides the framework within which this job can be accomplished. Research has provided many of the premises on which the system is based. Additional premises are drawn from the basic concepts, elements, principles, and variables of visual resource management described in National Forest Landscape Management, Volume 1, Agriculture Handbook No. 434.

CHARACTER TYPE

An area of land that has common distinguishing visual characteristics of landform, rock formations, water forms, and vegetative patterns is called a character type. Its establishment is based on physiographic sections as defined by Nevin M. Fenneman (1931).

This map indicates the 16 major visual character types of the Pacific Northwest.

Character types are used as a frame of reference to classify physical features of a given area as to their degree of scenic quality. (See section on Variety Class.)



1/ Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

2/ Assistant Chief Landscape Architect, Forest Service, USDA, Washington, D.C.

3/ Forest Service Manual 2380, Landscape Management, USDA.

CHARACTER SUBTYPE

In some cases, the major character type will be too broad or great in diversity of character to provide a logical frame of reference to clasify physical features. For such situations, each major character type may be further broken into subtype.

CHARACTERISTIC LANDSCAPE

The characteristic landscape is the naturally established landscape being viewed. It visually represents the basic vegetative patterns, landforms, rock formations, and water forms which are in view. It usually makes up a small portion of a character subtype depending on how much is viewed.

VARIETY CLASSES

Variety classes are obtained by classifying the landscape into different degrees of variety. This determines those landscapes which are most important and those which are of lesser value from the standpoint of scenic quality.

The classification is based on the premise that all landscapes have some value, but those with the most variety or diversity have the greatest potential for high scenic value.

There are three variety classes which identify the scenic quality of the natural landscape:

CLASS A - Distinctive
CLASS B - Common
CLASS C - Minimal

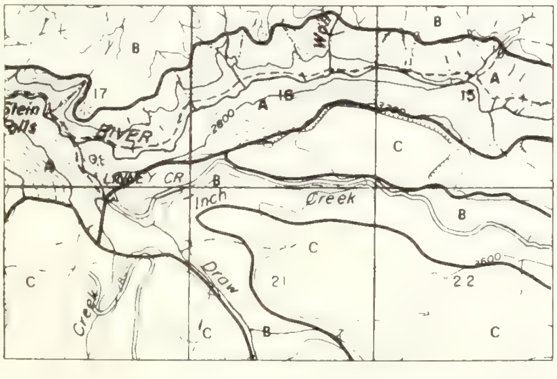


Figure 1--*An overlay as shown above is prepared to illustrate the variety class determination.*

A frame of reference must be developed by which to judge the physical features of an area as distinctive, common, or minimal (Class A, B, or C). This is derived from the character type or subtype. Features such as landforms, water forms, rock formation, and vegetative patterns are compared singularly or in combination with those commonly found in the character type. Through this comparison, an area's overall degree of scenic quality and resultant variety class rating may be determined.

Ranking the Class B features within the area should be done first as a means of establishing a benchmark from which distinctive and minimal can be judged. The exceptions are those subtypes in which the features common to the character type are outstanding in quality and/or known nationally for their scenic importance. These features should be ranked Class A even though they are common to the character type.

Class A is the ranking given to those areas with features more distinctive or unusual than those defined in the Class B benchmark established above. Class A features usually exhibit a great deal of variety in form, line, color, and texture. Landform, rock, water and vegetation stand out as being unusual and/or outstanding in visual quality compared to those found common in the character type.

Class C features have very little variety, if any, in form, line, color, and texture. Water forms, because of their high attractiveness to people, should not generally fall into this category. Exceptions will depend on the character type but might be very small stagnant ponds, intermittent streams, etc. There will be character types which have very little, if any, of the land and its features that fall into Class C.

SENSITIVITY LEVELS

Sensitivity Levels are a measure of people's concern for the scenic quality of the National Forests.

Sensitivity levels are determined for land areas viewed by those: traveling through the forest on developed roads and trails; are using areas such as campgrounds and visitor centers; or recreating at lakes, streams, and other water bodies. It is recognized that all National Forest land is seen at least by aircraft users. Therefore, some degree of visitor sensitivity will be established for the entire land base.

Three sensitivity levels are employed, each identifying a different level of user concern for the visual environment.

Level 1--Highest Sensitivity
Level 2--Average Sensitivity
Level 3--Lowest Sensitivity

The degree of visitor sensitivity to the visual environment is extremely difficult to quantify. Additional research into the sociological aspects of man's perception of his environment is essential. Various research scientists are investigating this concept in depth and changes will be made in the process as findings are published.

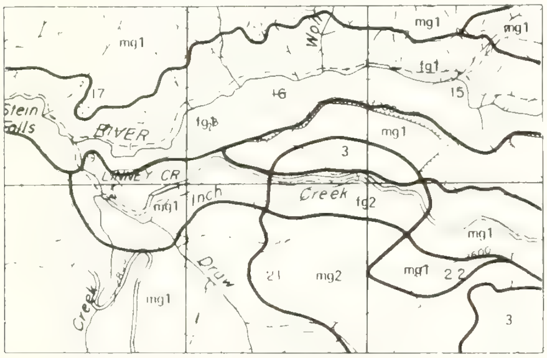


Figure 2--*Adjusted final seen area boundaries after conflicts involving sensitivity levels and distance zones have been resolved. The final overlay will show the seen area in terms of distance zones with the sensitivity level number of accompanying it.*

DISTANCE ZONES

Distance zones are divisions of a particular landscape being viewed. They are used to describe the part of a characteristic landscape that is being inventoried or evaluated. The three distance zones are: foreground, middleground, and background.

1. Foreground--the limit of this zone is based upon distances at which details can be perceived. Normally, in foreground views, the individual boughs of trees form texture. It will usually be limited to areas within 1/4 to 1/2 mile of the observer, but must be determined on a case-by-case basis as should any distance zoning.

2. Middleground--this zone extends from foreground zone to 3 to 5 miles from the observer. Texture normally is characterized by the masses of trees in stands of uniform tree cover. Individual tree forms are usually only discernible in very open or sparse stands.

3. Background--this zone extends from middleground to infinity. Texture in stands of uniform tree cover is generally very weak or no existent. In very open or sparse timber stands texture is seen as groups or patterns of trees.

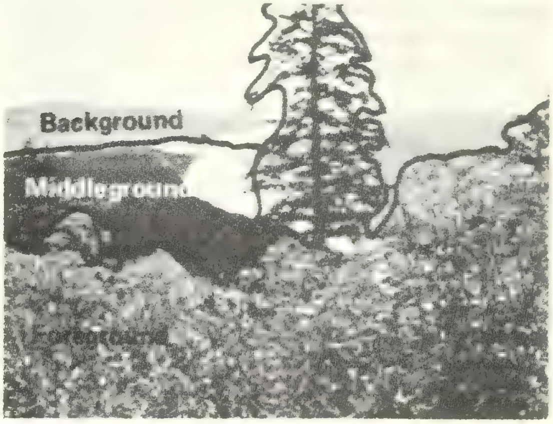


Figure 3

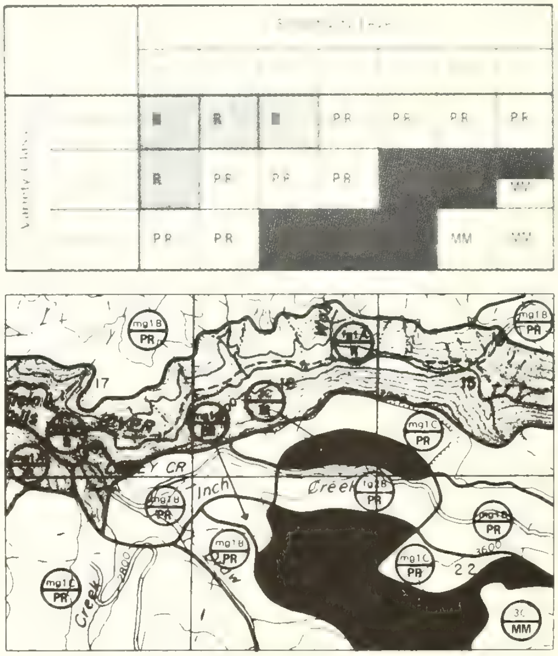


Figure 4--*Visual Quality Objectives are determined by comparing, on the chart, the variety class (A, B, or C) with the sensitivity level (fig.1,mg 2, etc.). By using a split-circle symbol and color codings, an appropriate objective (and the information from which it was determined) can be shown on each area of the map.*

The Visual Management System thus produces a map of visual quality objectives. This becomes the means by which National Forest landscape management objectives are recommended for consideration in land use planning if done at the broad scale, and proje decision making if done at a more detailed level.

PRESERVATION (P)

This visual quality objective allows ecological changes only. Management activities, except for very low visual-impact recreation facilities, are prohibited.

This objective applies to wilderness areas, primitive areas, other special classified areas, areas awaiting classification and some unique management units which do not justify special classification.

RETENTION (R)

This visual quality objective provides for management activities which are *not visually evident*.

Under Retention, activities may only repeat form, line, color, and texture which are frequently in the characteristic landscape. Changes in their qualities of size, amount, intensity, direction, pattern, etc., should not be evident.

Duration of Visual Impact

Immediate reduction in form, line, color, and texture contrast in order to meet Retention should be accomplished either during operation or immediately after. It may be done by such means as seeding vegetative clearings and cut-or-fill slopes, hand planting of large stock, painting structures, etc.

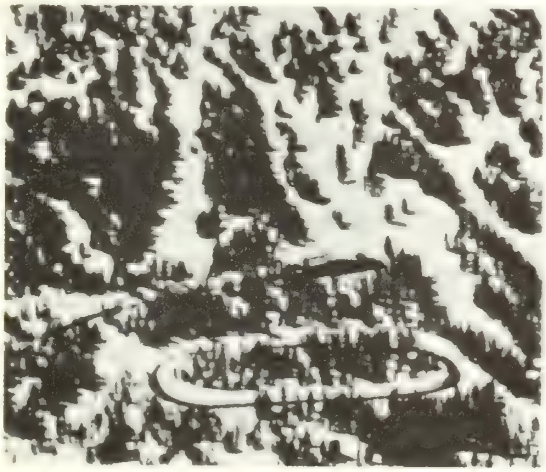


Figure 5--*The vegetative clearings for the ski runs and lifts above the parking area (above) would not be visually evident to the casual forest visitor. The clearings repeat form, line, and texture from the surrounding vegetative patterns to achieve the retention objective.*

PARTIAL RETENTION (PR)

Management activities remain *visually subordinate* to the characteristic landscape when managed according to the partial retention visual quality objective.

Activities may repeat form, lin e, color, or texture common to the characteristic landscape but changes in their qualities of size, amount, intensity, direction, pattern, etc., remain visually subordinate to the characteristic landscape.

Activities may also introduce form, line, color, or texture which are found infrequently or not at all in the characteristic landscape, but they should remain subordinate to the visual strength of the characteristic landscape.

Duration of Visual Impact

Reduction in form, line, color, and texture to meet partial retention should be accomplished as soon after project completion as possible or at a minimum within the first year.

MODIFICATION (M)

Under the modification visual quality objective management activities may visually dominate the original characteristic landscape. However, activities of vegetative and land form alteration must borrow from naturally established form, line, color, or texture so completely and at such a scale that its visual characteristics are those of natural occurrences within the surrounding area of character type. Additional parts of these activities such as structures, roads, slash, root wads, etc., must remain visually subordinate to the proposed composition.

Activities which are predominately introduction of facilities such as buildings, signs, roads, etc., should borrow naturally established form, line, color and texture so completely and at such scale that its visual characteristics are compatible with the natural surroundings.

Duration of Visual Impact

Reduction in form, line, color, and texture should be accomplished in the first year or at a minimum should meet existing regional guidelines.

MAXIMUM MODIFICATION (MM)

Management activities of vegetative and landform alterations may dominate the characteristic landscape. However, when viewed as background, the visual characteristics must be those of natural occurrences within the surrounding area or character type. When viewed as foreground or middleground, they may not appear to borrow completely from naturally established form, line, color, or texture. Alterations may also be out of scale or contain detail which is incongruent with natural occurrences as seen in foreground or middleground.

Introduction of additional parts to these activities such as structures, roads, slash, and root wads must remain visually subordinate to the proposed composition as viewed in background.

Duration of Visual Impact

Reduction of contrast should be accomplished within five years.

VISUAL ABSORPTION CAPABILITY OR VULNERABILITY

On some lands where the visual resource is of paramount importance, the setting of VRM objectives or standards is sufficient for management needs. In other areas, however, managers or owners will, in addition, insist upon some indication of the degree of difficulty (or costs) expected in meeting those objectives. In other words, some require a measurement of the land's capability to absorb change without significantly affecting visual character. This is normally done by analyzing such factors as slope, aspect, soil color, vegetative regeneration potential, etc. Williamson (1976) lists almost 70 such factors and believes that still others may be useful on occasion. Conversely, many broadscale planning efforts have been well done using as few as three factors.

The correlation between Visual Quality Objectives (VQO) and Visual Absorption Capability (VAC) is not as straightforward as it might first appear. The most restrictive objectives are not necessarily the most difficult or costly to attain, although that is often the case. Some visually tolerant landscapes, usually those of considerable variety, can be managed to meet high VQOs with relative ease.

VAC rating systems have been developed by Jacobs and Way (1969) and Anderson, Chandler, et al. (1977). A slightly different approach was made by Litton (1974). Official Forest Service direction on VAC is found in the FOREST SERVICE MANUAL, 2383.2, which can be examined at any Forest Service office.

Factor inventory data is noramlly mapped at the same scale and on the same base maps as the VQOs. It is then easy for any site or acreage to compare the visual quality (management) objectives with the lands' visual absorption capability. The process is not illustrate here for lack of space but is readily available from the above sources.

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The Bureau of Land Management and Visual Resource Management—An Overview[1]

Robert W. Ross, Jr. [2]

Abstract: The Bureau of Land Management (BLM), an agency established in 1946 through consolidation of the Grazing Service and the General Land Office, has exclusive responsibility for about 60 percent of all Federal, civil, and defense administered lands. Although the primary policy of the Bureau has been land retention and multiple-use-management, the passage of the Federal Land Policy and Management Act of 1976 strengthened and redefined this role. Now strongly worded legislation very explicitly states that a basic policy of the Bureau will be management of environmental values including, among other, scenic resources. The Bureau's visual resource management (VRM) system is an analytical process which identifies and sets objectives for maintaining scenic values and visual quality.

INTRODUCTION

It's been said that in America there is more space where nobody is than where anybody is ..., and that's what makes America what it is. Perhaps there is no place that statement is more true than in the great, open space of the western United States and Alaska. We, of course, still think of this as America's own land of opportunity, adventure, intrigue, mystique, and enchantment.

The history of federally-owned or controlled lands is indeed a chronicle of our Nation and her people; of their struggles, failures, and successes. It also provides a perspective of our own sensitivity to the land and its resources, as a provider for present and future generations.

The Bureau of Land Management (BLM), an agency within the Department of the Interior, oversees about 60 percent of our Nation's federally-owned lands. Of this 400-plus million acres, about half is located in Alaska with the remaining in the far west and small areas scattered throughout the rest of the nation. Other major landholding agencies in the Department of the Interior include the National Park Service, Fish and Wildlife Service, and the Bureau of Reclamation. The U.S. Forest Service (USFS), U.S. Department of Agriculture, has jurisdiction over 24 percent of the total Federal ownership.

In addition to 63 million acres of subsurface mineral rights located primarily in the eastern United States, the BLM is also responsible for the management of several million acres of the Outer Continental Shelf (OCS), which extends up to 200 miles off the east, west, and gulf coasts of the United States.

As the rush to settle the West continued, and paths became trails, trails became roads, and roads became super highways; the role and responsibility of the Federal Government changed dramatically. In 1946, President Truman officially created the BLM through consolidation of the General Land Office and the Grazing Service. The primary policy evolution for the BLM since then has been land retention and multiple-use resource management for the benefit of the public.
Today, the BLM administers many resources on these public lands, guided by congressional mandate which, in part, states that "multiple

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Chief Landscape Architect, Division of Recreation, U.S. Department of Interior, Washington, D.C. 20240

use and sustained yield" is a major part of the BLM's responsibility.

Among these resources are: timber, minerals, oil and gas, geothermal energy, wildlife habitats, livestock forage, endangered plant and animal species, recreation and cultural areas, wild and scenic rivers, and watersheds. In 1977 alone, revenues from these lands and resources, administered by the BLM, totalled more than 3 billion dollars. Managing vast and varied resources under this mandate is a complex undertaking, particularly, since the priorities set for one activity may often conflict with the priorities set for another.

The BLM has another recent but certainly equal mandate. That is, to give priority to the protection of the environment including scenic values. Along with growing public concern for the quality of our environment has come an awareness, on the part of both the public and land managers, that scenic or visual values are important public resources and must be managed as such.

Understanding and managing the visual aspects of alterations to the natural landscape are particularly important to the BLM, because many of the activities taking place on its lands involve some degree of alteration. Recent legislation, the Federal Land Policy and Management Act of 1976 (FLPMA), set basic policy for the BLM's management of public lands. The key requirements are contained in section 102(8), which states that:

> "The public lands be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values; that, where appropriate, will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy and use."

The Act, thus, makes protecting scenic and other environmental values an explicit criterion that must also be applied throughout the BLM's land management activities.

FLPMA also places new emphasis on the role of land use planning by requiring that resource management plans "give priority to the designation and protection of areas of critical environmental concern."

The criteria for identifying these areas are stated in the definition section 103(a):

> "... areas ... where special management attention is required...to protect and prevent irreparable damage to important historical, cultural, or scenic values, fish and wildlife resources or other natural systems or processes or to protect life and safety from natural hazards."

The National Environmental Policy Act of 1969, which seeks to provide aesthetically pleasing surroundings for all Americans, calls for the development of procedures to ensure that presently unquantified environmental values are given appropriate consideration in decisionmaking. It also requires, "utilization of a systematic, interdisciplinary approach, which will ensure the integrated use of ... environmental design arts in planning and decisionmaking.

The Surface Mining Control and Reclamation Act of 1977 makes minimizing adverse effects on visual resources a requirement for all surface mining activities.

The Clean Air Act amendments of 1977 also establish the importance of scenic values in determining airshed classifications and managing air quality.

In conjunction with its land planning and management responsibilities, the BLM is committed to managing visual resources and concurrently, to minimizing the adverse visual impacts of land use practices on its lands. As a result, the BLM requires that visual resource considerations be included in all environmental assessments, in all land use planning decisions, and in the implication of all resource projects.

Because the scenic value of public lands varies, however, and because management objectives also vary, it is not practical to provide a uniform level of protection to all the BLM lands. The BLM has, therefore, developed a system for evaluation visual resources and for determining what degree of protection, rehabilitation, or enhancement is desirable and possible. This Bureauwide system has been developed to provide an interdisciplinary approach to the visual resource management process. The system, which is integrated into the BLM procedures for "Multiple-Use Planning and Environmental Analysis" insures that principles of the environmental design arts are applied to all activities on the BLM land that may modify the landscape.

The system, as known to the BLM, is still pretty new. In fact, those directly associated with visual resource management in the BLM are still considered the "new kids on the block." In November of 1975, VRM in the BLM became legal when the new visual resource section of the manual was signed and the program became official Bureau policy. Now, with nearly 50 landscape architects in the various 13 western States, including State and District Offices, the Denver Service Center and Washington, D.C., there is an extensive and intensive ongoing training program in visual resource management and the key support field of computer graphics. In addition, there has already been one major manual updating and the program has received considerable strength and support from a cadre of young energetic professionals who are constantly questioning, criticizing, and making suggestions for improvement, as well as providing for proper visibility and communication of the program.

A project currently underway involves the development of a series of guidebooks to be used by both public and private project planners and decision-makers to assist in understanding how to assess and mitigate the adverse visual impact of various resource development activities before changes occur on public lands. They will also be used to guide in rehabilitation or enhancement of visual resources after a project has been implemented. The guidebooks will concentrate on activities that have the greatest potential for creating adverse visual impact, such as: energy production and transportation, energy extraction, forestry, recreation, and range management. One guidebook, which is somewhat different in format, will present techniques to simulate visual impact and to monitor completed projects for compliance with visual resource management standards.

The BLM's Visual Resource Management (VRM) System is an analytical process that identifies, sets, and meets objectives for maintaining scenic values and visual quality.

The system is based on recent research that has produced ways of assessing aesthetic qualities of the landscape in objective, universally recognizable terms. What had been considered extremely subjective (aesthetic judgement, particularly in the landscape) was found to have identifiable consistent qualities which can be described and measured, and about which people with diverse opinions will tend to agree. Whatever the terrain (and whoever the observer), perception of visual quality in a landscape seems to be based on several common principles including:

Landscape character is, for the most part, determined by the four basic visual elements of FORM, LINE, COLOR, TEXTURE. Although all four elements are present in every landscape, they exert varying degrees of influence.

The stronger the influences exerted by these elements, the more interesting the landscape.

The more visual variety in a landscape, the more aesthetically pleasing that landscape. Variety without harmony, however, is unattractive, particularly in terms of man-made alterations (cultural modifications) that are made without care.

The BLM incorporates these and other principles in a broad program for managing visual resources.

The VRM program functions in these three ways:

First, the program initiates the inventory and evaluation of visual resources on all lands under the BLM jurisdiction (Inventory/ /Evaluation). Once inventoried and analyzed, these lands are given relative scenic value ratings. Action plans are then developed for improving or preserving the scenic values of each parcel.

Second, the VRM program responds when development is proposed on the BLM land, either by the Bureau itself (through its multiple-use planning activities), or by private parties. Proposed development is measured against VRM scenic quality classes through the Contrast Rating process (Environmenal Assessment for Visual Resources).

Similarly, VRM standards and techniques can be used when proposed activities are still in the design stage to determine in advance, the visual impact of an activity and the extent to which mitigation measures will be required to make a project acceptable (Visual Resource Designs).

Third, the VRM program functions on a support level; through the development of graphic simulation techniques to model visual impacts, through monitoring actual visual impacts of new development activities, and through the publication of technical reports (such as the guidebooks in this series) that disseminate current information on the program (Support Elements/ Monitoring and Compliance).

INVENTORY/EVALUATION

Evaluation of the visual quality of the landscape, the sensitivity of that landscape to change, and distance determine classes in the Visual Resource Management system. Although the details of the evaluation system are intricate, the evaluation process itself is quite straightforward.

SCENIC QUALITY

Scenic quality is perhaps best described as the overall impression one retains after driving through, walking through, or flying over an area of land. When scenic quality is inventoried, an area is first divided into sub-units that appear generally homogenous in terms of land forms and vegetation. Each area is rated by seven key factors according to a consistent point system that allocates specific values to three levels of dominance for each factor.

The sum of the rating scores assigns each landscape to one of three Scenic Quality Classes: Class A = 19-33; Class B = 12-18; Class C = 0-11.

SENSITIVITY LEVELS

Although landscapes do have common elements that can be measured, there is still a subjective dimension to landscape aesthetics -- every viewer brings to the landscape perceptions formed by individual influences: culture, visual training, familiarity with local geography, and personal values.

To measure regional and individual attitudes for inclusion in the evaluation of a landscape, visual sensitivity is determined, in two ways:

Use Volume - Travel through an area (by road, trail, river) and the use of that area (for recreation, camping, events) are tabulated and then assigned a high/medium/low rating according to predetermined classifications.

User or Public Attitudes - Public groups are invited to workshops where they are familiarized with the landscape area, and then asked to respond to activities that will modify that landscape. The concern they express about proposed changes in scenic quality is rated as high, medium, or low.

A matrix then combines use volume and user attitudes in an overall Visual Sensitivity Rating of high, medium, or low.

DISTANCE ZONES:

The scenic quality of a landscape, user attitudes (and, therefore, the modifications acceptable or desirable) may be magnified or diminished by the visibility of the landscape from major viewing routes and key points. In the VRM system, a landscape scene may be divided into three basic "distance zones."

Foreground/Middleground - What is visible to an observer at a distance of 3 to 5 miles. At the outer boundary of this zone, the texture and form of an individual plant are no longer seen.

Background - What is visible to an observer at a distance of 3-5 to 15 miles, excluding objects perceived only by form or outline. Vegetation included in this zone should be visible, at least, as patterns of light and dark.

Seldom-Seen - What is visible to an observer beyond a distance of 15 miles or is obscured from view at closer range.

Atmospheric conditions may modify the perception of each distance zone. Also where several routes exist, what is foreground from one route may be background from another. (Usually, the closer designation is used.) For small projects, infield photographic assessment of distance zones is usually sufficient. For large projects, however, or projects that require evaluation from many key viewpoints, an alternative method for generating distance zone data is a computer graphic modeling technique such as the VIEWIT system developed by the USFS.

MANAGEMENT CLASSES

Visual resource Management Classes describe the different degrees of modification allowed in the basic elements of the landscape. In practice, the Management Class designation is derived from an overlay/matrix evaluation technique that identifies areas with similar combinations of factors and then assigns them to a VRM class according to predetermined criteria.

The resulting map of contiguous areas sharing the same VRM class is an important planning document for all BLM land-use decisions. It is used in the BLM's multiple-use planning process, then becomes the basis for developing visual resource management objectives, and is also used to assess the visual impact of proposed development activities.

Of the six classes, one is the Areas of Critical Environmental Concern (ACEC) and the remaining five are the established five classes: ACEC's are lands of high scenic value and relative scarcity.

Class I. This class provides primarily for natural ecological changes; however, it does not preclude very limited management activity. Any contrast created within the characteristic environment must not attract attention. It is applied to wilderness areas, some natural areas, wild portions of the wild and scenic rivers, and other similar situations where management activities are to be restricted.

Class II. Changes in any of the basic elements (form, line, color, texture) caused by a management activity should not be evident in the characteristic landscape. A contrast may be seen, but should not attract attention.

Class III. Contrasts to the basic elements (form, line, color, texture) caused by a management activity may be evident and begin to attract attention in the characteristic landscape. However, the changes should remain subordinate to the existing characteristic landscape.

Class IV. Contrasts may attract attention and be a dominant feature of the landscape in terms of scale; however, the change should repeat the basic elements (form, line, color, texture) inherent in the characteristic landscape.

Class V. Change is needed, or change may add acceptable visual variety to an area. This class applies to areas where the naturalistic character has been disturbed to a point where rehabilitation is needed to bring it back into character with the surrounding landscape. This class would apply to areas identified in the scenic evaluation where the quality class has been reduced because of unacceptable cultural modification. The contrast is inharmonious with the characteristic landscape. It may also be applied to areas that have the potential for enhancement, i.e., add acceptable visual variety to an area/site. It should be considered an interim or short-term classification until one of the other VRM class objectives can be reached through rehabilitation or enhancement. The desired visual resource management class should be identified.

CONTRAST RATING SYSTEM

A measure of the ease with which a proposed activity can be inserted into a landscape is the contrast of that activity with the basic elements of the landscape. Assessing the contrast of a proposed project against the form, line, color, and texture of the existing setting is a simple, but effective, demonstration of the modifications that may be required to meet a desired landscape quality.

To accomplish this, the BLM Contrast Rating procedure is applied to all proposed development and management activities. This procedure first breaks a landscape down into its major features (land and water, vegetation, structures) and each feature, in turn, into its basic elements (form, line, color, texture). Assessing the predicted contrast of a proposed activity against each feature in the landscape readily indicates the anticipated severity of visual impact.

In the Contrast Rating system, the ease of detecting contrast in the basic elements ranges from the highest rated (form) to the lowest rated (texture). By assessing degrees of contrast in each of the major features, a multiplier can be derived that indicates intensity of contrast.

More specifically, there are acceptable maximum ratings for each element, and any one feature for each visual resource management class.

Since each activity proposed for BLM land must pass through this evaluation, it has the potential to be useful in order to identify and mitigate extreme contrasts in the planning/design stage.

Soil Conservation Service Landscape Resource Management[1]

Sally Schauman[2]

Carolyn Adams[2]

Abstract: SCS Landscape Resource Management (LRM) is the application of landscape architecture to SCS conservation activities. LRM includes but is not limited to visual resource management. LRM can be summarized in three principles: (1) SCS landscape architecture considers the landscape as a composite of ecological, social and visual resources; (2) SCS landscapes exist in the countryside or suburban setting rather than in wildland or wilderness; (3) The American public has expectations of countryside landscape resources that most likely differ from their expectations of all other types of landscapes.

INTRODUCTION

To understand the concept of landscape resource management devised by Soil Conservation Service (SCS) landscape architects, it is necessary to understand the agency--its mission, its public, its methods of technology transfer, and the broad range of programs and activities within its sphere of authority.

SCS was created in 1935 and has been charged to provide information, technical expertise, and a delivery system for assisting land users with the conservation and use of soil, plants, and woodlands; watershed protection and flood prevention; the conservation, development, use, and disposal of water; animal husbandry; fish and wildlife management; recreation; community development; and related resource uses. Unlike other federal agencies, SCS does not control or manage public lands. Rather, the agency seeks to influence land users, through technology transfer and education, to use the best available conservation and resource management practices.

SCS operates primarily in countryside and suburban landscapes through a delivery system consisting of about 3,000 field offices. These offices are situated throughout the 50 states, and field personnel work in a diversity of landscapes ranging from Northeastern marshes (for cranberry production) to the semiarid Southwest plains (for fiber production).

Some SCS activities (construction of dams and channels) have potential for disrupting the landscape, while others (erosion control, reclamation of abandoned mine lands) are directed toward rehabilitating derelict land.

In either case, SCS recognizes its role in improving environmental quality through conservation of the landscape resource. It is USDA's belief that "... America's actions in the 1980's regarding food-and-fiber and natural resources policies may well have the strongest influence in shaping the society and the landscape of the next century" (USDA 1979).

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Landscape Architects, U.S. Department of Agriculture, Soil Conservation Service Washington, D.C.

LANDSCAPE ARCHITECTURE IN SCS

All of these factors collectively require SCS landscape architects to deal with the landscape resource as a broad concept. SCS landscape architecture can best be explained through discussion of several principles.

1. SCS landscape architecture considers the landscape as a composite of ecological, social and visual resources (SCS 1975).

This approach differs from visual resource management systems primarily in its contextual consideration of social resources. Such social consideration includes an analysis of benefits, both direct and indirect, derived from landscape use.

Countryside and suburban landscapes differ from resource lands controlled by federal agencies in one major respect: the former are generally the site of continuous human habitation and activity. Landscape resources must be analyzed in terms of public perception of them and of their functional use. For example, a fencerow planting in the Midwest may be valuable as a visual resource because it adds diversity and contrast to an otherwise monotonous landscape, but is also provides definable benefits such as wind protection, dust control, etc. These benefits cannot be ignored when impacts of potential management activities are assessed.

2. SCS landscapes exist in the countryside or suburban setting rather than in wildland or wilderness.

SCS only infrequently deals with wildland landscapes. Human-modified landscapes, whether countryside or suburbs, are generally dominated visually by structures, patterns of human activity (e.g., roads and terraces), and patterns of visual resource elements.

The impact of management activities on all visual resource elements is assessed within a local context. For example, in the New England countryside, red barns often have local significance as landscape resources. The introduction of structures that are visually incompatible with existing structural elements may be unacceptable.

SCS projects and activities also occur on a broad spectrum of landscapes of diverse size ranging from windbreak plantings on several acres to agricultural land conversions on 60,000 acres. General procedures and methods for dealing with the entire spectrum can be outlined, but the landscape resource management plan must be prepared for a particular site in a local or regional context.

3. The American public has expectations of countryside landscape resources that most likely differ from their expectations of all other types of landscapes.

The historical development of the American countryside has created public expectations and perceptions of regional landscape resources. SCS landscape architects are concerned with learning the basis for these expectations, the elements that comprise scenic countryside and the degree of change that can be absorbed by countryside without destroying its traditional character. Examples of traditional landscapes are the cotton plantations of the South, tobacco farms of the Piedmont and wheat fields of the High Plains.

THE RESOURCE MANAGEMENT SYSTEM

These observations form the base on which a broad, landscape resource management system is being formulated. The system will not be rigid. The diverse programs of the agency and the variety of landscapes in which the activities occur require a flexible approach. This approach is composed of three major efforts: preparation of technical information, training aids and workshops, and field testing of methods for landscape resource appraisal.

SCS Technical Release 65 (TR-65), "Procedure to Establish Priorities in Landscape Architecture," is an initial attempt to develop a system for identifying critical landscape resource management problems. TR-65 will be followed by a series of other documents to present additional levels of landscape resource investigations. Technical material is also being produced as integral parts of design manuals for specific structures such as open channels and farm ponds.

The major emphasis in the first year of SCS landscape resource management development has been in the area of training field personnel A large portion of the training is accomplished through self-contained audio visual training modules. Module 1, "Awareness" is currently being used in area, state and multistate workshops nationwide.

To date, field testing has been limited to studies in Mississippi and Massachusetts. The Mississippi experience consisted of a landscape resource inventory on a county scale that identified areas of important visual resource quality. The Massachusetts program inventoried resource areas (including visual) in several local communities. A "Q" sort method was used to judge local performance for various scenic resources.

It is anticipated that more extensive testing will be needed to determine the typical components of countryside landscape and assess the public's perception of these components.

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Legal and Policy Tools Available to Use in Solving Landscape Management Problems

Litigation and Landscape Esthetics[1]

Michael McCloskey[2]

Over the past two decades, the concerns of conservation groups have shifted in and out of the field of landscape esthetics. As the 1960's began, they tended to pursue their interests under the mantle of recreationists. By the mid-1960's, natural beauty became the watchword, particularly with the national encouragement of Lady Bird Johnson. By the late 1970's, the focus shifted to environmental quality, which in turn shaded into the notion of ecology.

These shifts involve more than just popular slogans. They express shifts in the scope of interests and the rationales involved. The "natural beauty" phase between 1964-1968 embodied a movement away from viewing recreation as a set of activity interests toward standards embodying notions of quality and culture. A strong effort was made in this connection to upgrade the value of "nature" as an element of national culture, the wilderness its purest expression. This natural beauty phase helped pave the way for the next phase, that of "environmental quality." This succeeding phase picked up the notion of quality from natural beauty, though it focused on a broader set of values. As the campaign for natural beauty came to be administered in the negative terms of curbing junkyards, billboards, freeway cuts and looming power lines, the need for a movement which better expressed positive values gave rise to the phase which sought environmental quality itself. This phase quickly transmuted into the final phase of "ecology" which attempted to find a rationale for broad sets of values in relationships having scientific or objective aspects in order to garner greater public acceptance.

While the environmental movement emerging from this transition moved away from talking much about natural beauty by the early 1970's, ironically researchers associated with public land management agencies continued to try to find ways to relate to the concept of natural beauty in ways which were less subjective. Greater objectivity in the field would help insulate them against the uncertainties of political currents and court interventions. A literature has bloomed on the subject which, however, has been largely ignored by the environmental movement that was first instrumental in stimulating public interest in the subject. This literature attempts to devise methods of objectively classifying landscapes and measuring public reactions to modifications of it. While some useful insights can be gained from this literature, I suspect most environmental leaders feel that these efforts often belabor the obvious and represent agency efforts to justify their own value systems. They probably feel that environmental design is an art form which cannot be reduced to a cookbook any more than can architecture or landscape architecture. You can learn more about bad design and poor public acceptance by these inquiries than you can about good design. Man-made intrusions into the landscape can only be handled with good results if someone sensitive to good design, and skilled in it, is put in charge. Usually this doesn't happen. Among other things, such situations deal with symbolic and cultural value systems mixed in with questions of design arts. On top of these factors, such cases invoke varied personal experiences and reflect political competition between agency clientele groups. The techniques described in this literature may be useful in meeting some emerging needs, though, as in designating unsuitable areas for mining under the stripmine act and in defining areas of critical environmental importance in places such as Utah under the BLM Organic Act.

With so many elusive factors involved, environmental leaders have pursued their interest in preserving attractive landscapes through other methods. They did not want to be trapped into a position of trying to justify values which would look like elitist judgments. In fact, tastemakers in our culture with respect to the landscape have always been tied closely to intellectuals and artists. Their tastes and traditions gradually influence popular reactions through the medium of education.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Executive Director, Sierra Club, San Francisco, California.

However, environmental leaders believe that it is far wiser to regulate manipulation of the landscape through environmental regulations than through esthetic regulations. Reclamation under the Surface Mine Reclamation Control Act will in fact minimize the ugliness caused by strip mining for coal. By requiring that high walls be eliminated, that the original contour in hilly country be restored and by planting native vegetation, all sorts of environmental problems will be dealt with (erosion, acid drainage, access for migrating wildlife, etc.). In the process esthetic problems will also be incidentally minimized. But there will be no need to argue with an industry or agency about the esthetics of highwalls. They will just be eliminated.

The National Forest Management Act of 1976 flatly requires that limits be placed on the size of clear cuts, rather than leaving us with an endless argument over the relative esthetics of massive clear-cutting. The Clean Air Act amendments of 1977 require that visibility in Class I airsheds, subject to the requirement for the "prevention of significant deterioration," be maintained according to definite standards. A continuing argument over social preferences among southern Utah residents for extended visibility is not pursued. Such arguments would be no more enlightening than surveying the reactions of people to junkyards or slaughtering plants. Those who make their livings in such facilities will probably find a way to bend their normal instincts to rationalize a tolerance for them, but most people will not react that way.

In fact, I would tend to argue that it is more likely that good environmental housekeeping will produce acceptable asthetic results than conversely. In most cases, detailed environmental regulations in the field of surface mining for coal, for instance, will produce a reasonably attractive landscape. However, landscape programs alone will not protect the public from toxic leachate from copper mine tailings ponds nor from radioactive vegetation on attractively regraded and planted uranium mine tailings. Moreover, a debate over the esthetics of tailing pile landscaping can divert attention from less visible but more insidious problems of this sort. I personally witnessed an example of this problem last summer in connection with a review of the status of copper mining south of Tuscon, Arizona, by the National Academy of Science. Too much time was taken up debating whether the screening of the tailing piles was adequate for those who could see them from a nearby retirement center, and almost no time was spent on reviewing the state of knowledge about possible contamination of the aquifer with heavy metals leaching out of the tailing ponds.

In almost every case, there are physical and biological handles on environmental problems that present far better opportunities for remedial action than the esthetic ones. And I would submit that when these non-esthetic handles are used to affect a remedy, much of the esthetic problem will also be reduced.

Environmental law has tended to follow the changing overall strategies of the environmental movement. Litigation has illuminated questions at the cutting edge of controversy. However, esthetics have not tended to be at the cutting edge of environmental controversy because both the general strategies have moved away from questions of esthetics and litigation is not well suited to deal with a subject matter which inherently is so subjective. Litigation in the field of public law depends on demonstrating that agencies have either failed to stay within a legally mandated boundary line or have failed to cross it when they were required to. In cases of injunctive relief, the plaintiffs most often must show that discretion has been abused through arbitrary and capricious behavior. This is particularly hard to show when dealing with a question as subjective as esthetics. About the only clear grounds for a suit based upon esthetics would be in a case where the agency had a duty to consider esthetic factors and made no record whatsoever showing it had done so in a professional manner, or where an EIS did not even discuss esthetics. The question is most likely to draw attention in future litigation when a federal reservation is established primarily for esthetic reasons (possibly NRA's) and the compatibility of developmental activity is in question (e.g., mining and housing). But here the outcome will likely turn on the exact phraseology used in the statute on the question of compatibility.

An agency is likely to get sued on questions of esthetics only when it has a clear responsibility to pay some attention to such questions and totally neglects to do so. Otherwise, the matter is likely to get addressed largely through legislation establishing a regulatory regime designed to produce a result which meets more objective environmental criteria but incidentally also produces an attractive landscape.

The Interface of Legal and Esthetic Considerations[1]

Richard C. Smardon[2]

Abstract: This paper is an overview of development of legal/policy factors affecting visual resource management. Review of major legal issues, court cases, laws and administrative decisionmaking reveals that the "action" regarding legal and aesthetic issues is currently in the public arena as managed by administrative agencies.

Analysis of key court cases reveals that the courts always go back to the "context" at hand to make a decision, and that existing legislation mentioning and/or providing inclusion of aesthetic or visual resources in environmental planning and decisionmaking creates a "protective net" over much of the Federal and common trust lands and resources. Failure to consider adequately visual resources in many cases could be grounds for citizen suits although legal action is diminishing and more activity lies within agency administrative discretion. Detailed legislation, citing the contextual aesthetic properties and management prescriptions of an individual area, and/or detailed agency inventory, analysis and management are sound strategies.

INTRODUCTION

Purpose

What do "The Old Man in the Mountain,"[3] "Scenic Hudson,"[4] "Mineral King,"[5] "Rainbow Bridge,"[6] "Walton v. St. Clair,"[7] East Meadow Creek,"[8] "Overton Park,"[9] and "Death Valley Monument"[10] all have in common? They are all major federal court cases which have been essential to the development of environmental law and have all developed from controversy arising from agency treatment or non-treatment of aesthetic and environmental values. They are all cases of the "pig in the parlor" or, what is or is not an appropriate action given the context of a highly aesthetic or scenic public environment whose aesthetic qualities are believed to be threatened. The primary purpose of this paper is to explore in detail the "pig in the parlor" question and to gain a structured overview of the ways in which aesthetic values have a substantial legal basis for environmental planning activities.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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[3] Appalachian Mountain Club _et al_. v. Claude S. Brinegar _et al_., 394 F. Supp. 105 (U.S. Dist. Ct. D.N.H. March 26, 1975).

[4] 354 F. 2d 608 (2nd Cir. 1965), cert denied, 384 US (1966).

[5] Sierra Club v. Morton, 92 S.Ct. 1361, 405 US 727 (1972).

[6] Friends of the Earth v. Armstrong, 485 F. 2d 1 (10th cir. 1973).

[7] Walton v. St. Clair, 313 F. Supp. 1312 (1970).

[8] Parker v. US, 448 F. 2d 793 (1971) _cert den_ 92 S.Ct. 1252 (1971).

[9] Citizens to Preserve Overton Park v. Volpe, 401 US 402, 91 S. Ct. 814 (1971).

[10] Death Valley National Monument _et al_., v. the Dept. of the Interior et al., Civ. Act No. 76-401 (D.N.D. Cal. filed Feb. 26, 1976).

In doing the above, the author is not solely examining the importance of specific court cases or administrative or legislative programs, but is assessing the likelihood of major trends. For instance, are aesthetic values gaining a greater legal basis for incorporation into environmental planning and decisions? If so, what are the key legal criteria or tests involved? Which mode of law seems best to treat aesthetic value questions? Is it 1) common law/nuisance doctrine, 2) the use of police power, 3) the use of eminent domain, or 4) legislation? Or are there other modes or combinations of modes? Finally, an often ignored question is what constitutes the best marriage of legal treatment as practiced by lawyers and administrators with use of aesthetic analysis and theory as practiced by landscape architects, planners and social scientists?

A substantial review (Smardon 1978) exists which addresses the courts' role in determining the legal basis for addressing questions of environmental aesthetics as well as federal, state and local legislation and controls which have attempted to provide for the consideration of environmental aesthetics in the planning process. We must develop a structure of analysis which is responsive to legal theory and constructs, to aesthetic theory and analysis, and to planning applications. There must be a "meeting of the minds" of the professions involved in these areas if environmental aesthetics is to evolve into an effective part of environmental planning processes.

EVOLUTION OF ENVIRONMENTAL AESTHETICS IN THE LAW

Common Law/Nuisance Doctrine

Let us look briefly at the evolution of aesthetic controls in environmental planning from early common law/nuisance doctrine, to use of the police power and eminant domain, and more recent uses of local, state and federal legislation and programs. The history and development of legal theory pertaining to aesthetic controls in environmental planning is inseparably linked to early activity in nuisance doctrine and use of police powers to control aesthetics primarily in urban environments.

Personal Injury

The fundamental issue in common law (i.e., rules of law not based on written statues) and/or nuisance doctrine and aesthetics is "recognition of visual annoyance as an element of personal damage."[11] The classic situation is a landowner's use of his or her property in a manner which offends neighbors' sensitivities or sense of aesthetics, such as operating a landfill or auto grave yard in a residential area. The criteria are subjective and the situations are infinite. Classic examples of visual nuisances which range from auto junkyards to "spite-fences," giant signs, storage tanks and funeral parlors.

In general, common law/nuisance cases have raised the question of whether real property owners could be denied "unsightly" uses of their land. Injunctions were usually sought which would modify or stop this "unsightly use." The usual response of the courts has been not to recognize such situations as constituting a nuisance. Courts feel uncomfortable administering a subjunctive standard relating to taste especially if it affects private property rights. The courts also have not found a useable negative standard relating to visual incongruity of land use or activity. However, courts have recognized personal smell and hearing nuisances.

There seems to be a number of exceptions to the above described situation given the following situations or rules of guidance:

1. The land use or activity would constitute a nuisance to the "normal man, the man of ordinary habits and ordinary sensibilities."[12]

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[11] Houston Gas and Fuel Co. v. Harlow, 297 S.W. 570 (Tex. Civ. App. 1907); and Leighty, 1971, Aesthetics as a Legal Basis for Environmental Control.

[12] Gus Blass Dry Goods Co. v. Reinman & Wolfort, 102 Ark. 287, 293, 143 S.W. 1087, 1090 (1912); accord, Cox v. Schlekhter, Ind. App.__, 262 N.E. 2d 550 (1920); and Stevens v. Rodoport Granite Co., 216 Mass. 486, 104 N.E. 371 (1914).

2. It can be proven that spite or malice was the motivation in obstructing the plaintiff's "right" to a comfortable, unobstructed view.[13]

In the latter case (#2) the emphasis of the courts' concern would be on proving spite or malice rather than any aesthetic damage. Because of the lack of an objective standard for case #1 above, the courts have rarely supported the supposition that "mere unsightliness" constitutes a nuisance. The only notable exception is Parkersburg Builders Material Co v. Barrach,[14] in which the court felt that an injunction would have been appropriate if the auto wrecking operation in question had been located in a predominately "residential" neighborhood. Thus, the court was taking steps to formulate the standard of visual land use congruity or compatibility as perceived by the "common or ordinary man." There has been visual landscape preference and evaluation testing work done which has used the criterion of congruity or compatibility of different land use combinations represented by photographs of actual landscapes or models. This includes landscape preference and evaluation work by Hendrix and Fabos (1975), and Wohwill (1978).

Public Injury

Recent advances in elimination of procedural obstacles to standing to sue on the basis of "public interest" rather than personal damages have provided the basis for class actions for equitable or declaratory relief. Many of the court cases critical to the development of liberalized rules of standing that let individuals or environmental groups gain access to the court system to litigate environmental issues also were cases with major environmental aesthetic issues.[15]

As defined in the Association of Data Proc. Serv. Org. Inc. v. Camp decision,[16] the Administrative Procedures Act[17] allows individuals or groups standing in order to sue for damage to the public aesthetic interest. Thus the plaintiff needs only claim an injury in fact to value ("right," "concern," or "interest") that is protected by law. The Supreme Court has further elaborated that this value may be aesthetic, conservational, or recreational.[18]

All of the above may do more for attainment of standing to sue than for justicability of aesthetic issues on their merits. Public interest litigation thus far has centered on statutory interpretations. An example in point would be the classic case of Scenic Hudson Preservation Conference v. FPC[19] where it was stated:

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[13] See Norton v. Randolf, 176 Ala. 381, 58 So. 283 (1912); Hormsby v. Smith, 191 Ga. 491, 13 S.E. 2nd 20 (1941); Flaherty v. Moran, 81 Mich. 52, 45 N.W. 381 (1890); Burke v. Smith, 69 Mich. 380, 37 N.W. 838 (1888); Dunbar v. O'Brien, 117 Neb. 245, 220 M.W. 278 (1928); Barger v. Barringer, 151 N.C. 433, 66 S.E. 439 (1909); Hibbard V. Halliday, 58 Okla. 244, 158 P. 1158 (1916); and Erickson v. Hudson, 70 Wp. 317, 249 r. 2d 523 (1952).

[14] 118 W. Va. 608, 191 S.E. 368, 192 S.E. 291 (1937)(concurring opinion).

[15] See Scenic Hudson Preservation Conf. v. FPC, 354 F.2d 608 (2nd Cir. 1965), cert. denied, 384 U.S. 941 (1966) (construction of a pump storage hydroelectric project at Storm King Mountain in New York); Izaak Walton League of America v. St. Clair, 313 F. Supp. 1312 (D. Minn. 1970) (mineral claims in the Boundary Waters Canoe Area); Citizens to Preserve Overton Park, Inc. v. Volpe, 309 F. Supp. 1189 (W.D. Tenn.), aff'd, 432 F.2d 1307 (6th Cir. 1970), rev'd, 401 U.S. 402 (1971)(highway corridor through a municipal park); Parker v. United States, 309 F. Supp. 593 (D. Colo. 1970) (Forest Service timber sale); Sierra Club v. Hickel, Civil No. 51,464 (N.D. Cal. 1969), order vacated, 433 F.2d 24 (9th Cir. 1970), cert. Granted, 401 U.S. 907 (1971)(commercial recreation development by Walt Disney Productions in Mineral King Valley of the Sequoia Nat'l Forest).

[16] Association of Data Proc. Serv. Org. Inc. v. Camp, 397 U.S. 150, 153-54 (1970).

[17] 5 U.S.C., s. 702.

[18] Sierra Club v. Hickel, 433 F. 2d 24, 32 (9th Cir. 1970), cert. granted sub. nom.; Sierra Club v. Morton, 401 U.S. 907 (1971), quoting Asso. of Data Proc. Serv. Org. Inc. v. Camp.

[19] Scenic Hudson Preservation Conf. v. FPC, 354 F.2d 608 (2d Cir. 1965), cert. denied, 384 U.S. 941 (1966) (construction of a pump storage hydroelectric project at Storm King Mountain in New York State).

> In order to insure that the Federal Power Commission will adequately protect the public interest in the aesthetic, conservational, and recreational aspects of power development, those who by their activities and conduct have exhibited a special interest in such areas must be held to be included in the class of 'aggrieved' parties under s. 313 (b). We hold that the Federal Power Act gives petitioners a legal right to protect their special interests.[20]

So it is important that aesthetic considerations be specifically mentioned within the applicable statutes which bear upon the case at hand, such as the Federal Water Power Act,[21] as the courts have not usually transcribed aesthetic considerations into case opinions. It is also clear in most states that environmental standards should be established through legislation and should not be the by-product of private litigation.

Few environmental cases have been won on the merits of the adequacy of treatment of aesthetic issues. Notable exceptions include Parker v. United States[22] and Citizens Committee for the Hudson Valley v. Volpe.[23] Both of those cases contained environmental issues with aesthetic factors, but each also had particular statutory language which was examined as in Scenic Hudson v. FPC. Citizens to Preserve Overton Park, Inc. v. Volpe[24] indicated that specific areas such as publicly owned park and recreation lands, wildlife refuges and historic sites may have significant aesthetic values and may be disrupted, by Department of Transportation funded projects, only under extraordinary circumstances. Again, there were specific statutes involved such as section 4(f) of the Transportation Act of 1966.[25]

A procedural problem exists in that groups or publics may not always gain standing to sue concerning recreation and aesthetic 'interests' as Scenic Hudson would indicate. Sierra Club v. Hickel[26] raised a critical procedural point. This point is that the adverse impact must be direct and immediate in the sense that local residents and users of the area must claim specific "injury." An outside conservation group claiming general concern or interest in the area would not have standing under the Sierra Club v. Hickel test. There have been much discussion and writing about the standing issue in general in regard to its application to environmental cases. Proper treatment of this issue is not possible within the confines of this paper.

The other important points to be gained from Sierra Club vs. Hickel are that the court would 1) be willing to discount the preservation aspects of aesthetic issues when a reasonable amount of planning to treat visual impacts can be demonstrated, and 2) acknowledge that most aesthetic considerations may be a matter of agency discretion. Thus agency procedures and guidelines for aesthetic planning may assume great importance, depending upon the extent to which courts become burdened with environmental aesthetic issues. In cases where the courts examined or interpreted existing specific statutory language, the agency regulations, guidelines, or processes would be accepted as reasonable by virtue of their existence, unless 1) they proved to be "arbitrary or capricious;" or 2) they were contradictory with original statutory language; or 3) they did not fulfill the original statutory language.

Both Leighty (1971:1370) and Broughton (1972:500) agree that despite the few cases dealing with aesthetic merits, private litigation will move toward " public interests" rather than "private injury." Leighty (1971:1370) stresses, however, that there needs to be pre-existing legislative or constitutional declarations of policy to sustain such cases.

Beyond Public (Personal?) Injury

The test for standing devised in the Mineral King case may be legally and administratively desirable, but it causes some serious conceptual problems from an environmental aesthetics perspective. The standing test restated is that one who is "injured in fact" also had to prove "injury" by proof of "use" of the area in question.

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[20] Id. 616.

[21] 16 U.S.C. s. 803(a) (1964).

[22] 309 F. Supp. 593 (p. Colo. 1970).

[23] 302 F. Supp. 1083 (S.D.N.Y. 1969) aff'd, 425 F. 2d 97 (2d Cir.) cert. denied, 400 U.S. 949 (1970).

[24] 401 U.S. 402 (1971).

[25] 49 U.S.C.A., s.1653(f), and 23 U.S.C.A. 138.

[26] 433 F. 2d 24 (9th CA. 1970), cert. granted sub. nom., Sierra Club v. Morton, 401 U.S. 907 (1971) and Walton v. St. Clair, 313 F. Supp. 1312 (1970).

Stone points out that some natural objects and landscapes are affected differently by common law than other natural objects or landscapes. For instance, rivers, lakes, oceans, dunes, air, streams (surface and subterranean), and beaches are held in common trust under the "public trust doctrine"[27] for the public to have legal access to, or enjoy certain uses of the area. These common trust resources would be treated differently than natural objects on traditionally private land such as a pond on a farmer's field, or a stand of trees on a suburbanite's lawn. Communal resources notwithstanding, however, Stone maintains that:

> None of the natural objects, whether held in common or situated on private land, has any of the three criteria of a rightholder. They have no standing in their own right, their unique damages do not count in determining outcome, and they are not beneficiaries of awards. (Stone, 1973:16)

Stone laments that even when measures have been taken to conserve natural objects it is for "our benefit" or "our use," an anthropocentric philosophy, and he advocates that the environment gain recognition for its own injuries through use of a guardian appointed solely to represent the interests of the environment. Stone's argument has ecological merit in its implications for the "rights" and "benefits" of the environment, but does little directly for environmental aesthetics. This is because environmental aesthetic values are dependent upon the interaction of man with the environment; we must feel it, see it, experience it, etc.

There has been some use of Stone's arguments. One of these uses is Justice Douglas's dissent to the Supreme Court decision on Mineral King[28] and a recent court case where the environment has sued in its own behalf, i.e., Death Valley National Monument et al v. The Department of Interior et al.[29] Aesthetic issues also figure prominently in this case as disfigurement of the desert landforms from mining activities is one of the major issues involved.

Use of the Police Power

A second legal basis for aesthetics is the use of the police power to control aesthetic or visual quality. Use of the police power to control aesthetic quality has been predicted since the 1900's,[30] but there still remain many problems with the use of police power for aesthetic control. According to Leighty the basic problem is that "police power can be exercised only in the traditionally accepted subject areas of public health, safety, welfare, and morals" (Leighty, 1971:1373).

Most courts until recently have been hesitant to include community appearance under public welfare, or if they did the issue of community appearance was "masked" by other issues dealing with public morals, health, or safety. Recent cases[31] however, have upheld the direct application of general welfare as a sufficient basis for exercising statewide police regulation concerning aesthetic resource use. Of these more recent cases Oregon City v. Hartke[32] goes farthest in two ways. First the case indicates that aesthetic values may provide a valid basis for public land use controls in Oregon, whether in condemnation proceedings or otherwise, and second, it suggests that aesthetics alone will support police regulation. However, this is the extreme progressive position and exceeds the general trend across the country.

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[27] Public trust doctrine could be used to acheive environmental protection. See Gould v. Greylock Reservation Comm'n, 350 Mass. 410, 215 N.E. 2d 114 (1966), discussed in Sax, 1970, The Public Trust Doctrine in Natural Resource Law: Effective Judicial Intervention, Mich. Law Rev., 68: 492-509.

[28] Douglas, April 19, 1972, Sierra Club v. Morton: Minority Opinion.

[29] Death Valley National Monument et al., v. the Dept. of the Interior et al., Civ. Act. No. 76-401 (D.N.D. Cal. filed Feb. 26, 1976).

[30] See Henry P. Chandler, 1922, The Attitude of the Law Toward Beauty, American Bar Asso. Journal, 8: 470-474; and Vance G. Ingalls, 1937, The Law of Aesthetics, American Bar Asso. Journal, 23: 191-193.

[31] See City of Phoenix v. Fehler, 90 Ariz. 13, 17, 363 P2d 607, 609-10 (1961); Cromwell v. Ferrier, 19 N.Y. 2d 263, 225 N.E. 2d 749, 279, N.Y.S. 2d 22 (1967); People v. Stover, 12 N.Y. 2d 462, 191 N.E. 2d 272, 240 N.Y.S. 2d 734, appeal dismissed, 375, U.S. 42 (1963); Oregon City v. Hartke, 240 Ore. 35, 400 P. 2d 255 (1965); Bilbar Constr. Co. v. Easttown Tmp. Bd. of Adjustment, 395 Pa. 62, 141 2d 85, 856 (1958).

Despite the apparent trend toward a quality environment for visual purposes, the absence of a clear standard or authority for legislation and other regulations grounded on aesthetics remains problematic for the use of aesthetic police power in most jurisdictions.

Eminent Domain and Scenic Easements

The use of eminent domain is closely related to the use of police power for aesthetic purposes. Instead of regulating the use without compensation for public purposes, eminent domain takes the title of the land in fee (in total) or partially in the form of an easement for public purposes. As with the use of police power, there are prominent constitutional issues involved with the use of eminent domain for aesthetic purposes such as conflict with Fifth and Fourteenth Amendments.

A direct illustration of the use of eminent domain for aesthetic purposes under state law is found in Kamrowski v. State.[33] This case dealt with a legislative program in Wisconsin for the condemnation of scenic easements along the Mississippi River to preserve natural, undeveloped views for passing motorists. The condemned area would continue to be used for agricultural production but could not be used for more intensive purposes such as residential or commercial. The scenic easement program was challenged on the basis that "public enjoyment of the scenic beauty of certain land is not a public use of such land...."[34] The court held that aesthetics may provide the dominant objective for a condemnation proceeding using support from an earlier case[35] which had declared that "enjoyment of scenic beauty is a legal right."[36] What is even more interesting is the definition of the public use in a purely aesthetic vein by the court:

> "The learned trial judge succinctly answered plaintiff's claim that occupancy by the public is essential in order to have public use by saying in the instant case, 'the occupancy is visual.' The enjoyment of the scenic beauty by the public which passes along the highway seems to us to be a direct use by the public of the rights in land which have been taken in the form of a scenic easement...[37]

The court ruled in favor of the scenic easement program. This concept of "visual occupancy" for scenic easements also corresponds closely with visual analytical tools being developed to define visual corridors and viewsheds.[38] Thus delineating viewsheds could lead to delineating areas of legal public "visual occupancy" which could be protected and maintained.

Federal, State, and Local Aesthetic Legislation and Programs

There is an ever increasing amount of legislation and resultant programs at the federal and state level which directly or indirectly call for aesthetic considerations (See Smardon 1978). Since most trends seem to point toward the need for existing statutory language to insure consideration of asethetic values in environmental planning; this is the major vehicle for ensuring adequate consideration of aesthetic values. In questions involving issues of standing, use of police power and eminent domain, courts generally look to existing legislation as an indication of public policy support and sensitivity to environmental aesthetics.

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[32] 240 Ore. 35, 400 P. 2d 255 (1965).

[33] 31 Wis. 2d 256, 142 N.W. 2d 793 (1966).

[34] Id. at 261, 142 N.W.2d at 795.

[35] Muench v. Public Serv. Comm'n, 261 Wisc. 492, 53 N.W.2d 514 (1952).

[36] Id. at 511-12, 53 N.W.2d at 522.

[37] 31 Wisc. 2d 256, 265, 142 N.W. 2d. 793, 797 (1966).

[38] For landscape analytic approaches to delineate "visual occupancy" or viewshed see; Michael R. Travis, Gary G. Elsner, Wayne D. Iverson, and Christine G. Johnson, 1975, VIEWIT: Computation of Seen Areas, Slope and Aspect for Land Use Planning, Pac. S.W. For. and Range Exp. Stn., Berkeley, Calif., USDA For. Serv. Gen. Tech. Report PSW-11, 70p.

What we find are A) broad (in scope) Federal and state legislative acts dealing with programs such as land use planning[39] or coastal zone planning[40] that directly include aesthetic considerations in their language, B) broad acts that contain indirect langauage[41] in relation to aesthetics, and C) specific legislation affecting specific agencies. Agency specific legislation can be subdivided into scenic corridor[42] protection and mandates for management of specific isolated land or water areas.[43]

Probably the National Environmental Policy Act[44] affecting Federal agency actions and statewide mini-NEPAs has had more potential for affecting aesthetic considerations than any other statute. This is because NEPA acts as a wide ranging net which catches many other applicable federal statutes in the process of assessing the environmental impacts of projects and activities. A Federal agency not only has to comply with NEPA itself, but many other interconnected Federal statutes as well as executive memoranda and Federal regulations.

Critical court cases in relation to NEPA and aesthetics are reviewed by Anderson (1973:29-44) and the Environmental Law Recorder. Most of the significant court cases dealing with NEPA and aesthetics are those which address the issue of standing as previously discussed in this paper. According to Anderson the standing test developed in Sierra Club v. Morton[45] has presented no insurmountable barriers to environmental groups in attaining standing to sue on aesthetic and environmental grounds under NEPA. For instance the plaintiffs in West Virginia Highlands Conservancy v. Island Creek Coal Co.[46] successfully claimed injury under "aesthetic, conservational, or recreational interests." Other NEPA cases with similar rationales of "use" to gain standing include the Cross-Florida Barge Canal Case[47], Brooks v. Volpe[48], and Kalur v. Resor.[49]

In other NEPA cases groups gained standing under "aesthetic, recreational, or conservational interests" by combining the criterion of "use" with neighborhood proximity.[50] Lower court decisions handed down after Sierra Club v. Morton had no problems with standing as long as they included the specificity of "use" dictated by Sierra. Thus the Sierra Club v. Morton test as used in NEPA cases has not proven to be an impossible hurdle to jump in order to gain standing by alleging injury to "aesthetic, recreational, or conservational interests."

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[39] See Hawaii Land Use Law #187, 961, Hawaii Rev. Stats. s. 205 et seq.(1968); Vermont Act 250, 1970, 10 Vermont Stats. s.s. 6001-6091 (Supp. 1970); Maine title 38, Maine Rev. Stats. s.s. 401-488 (Supp. 1970): Oregon Rev. Stats. Ch. 197,s.s. 215.505 -.535; and Appalachian Regional Development Act, 1965, Pub. l. No. 91-148, 83 Stat. 360.

[40] See Coastal Zone Management Act of 1972, 16 U.S.C., s. 1451 et seq.; Tahoe Regional Planning Compact, 1969, Pub. L. No. 91-148, 83 Stat. 360; California Coastal Act of 1976, Calif. Resources Code, Div. 20, Art. 6, s. 30251; and Delaware Coastal Zone Act, Ch. 70, Title 7, Del. Code Anno. s.s. 7001 et seq (1968).

[41] See Michigan Environmental Protection Act, Mich. Comp. Laws Anno. s.s. 691.1201 -1207 (Supp. 1971); The Fish and Wildlife Coordination Act, 16 U.S.C. s.s. 661-66 (1970); and the Multiple use Sustained Yield Act of 1960, 16 U.S.C. s.s. 528, 31 (1970).

[42] See Highway Beautification Act of 1965, 23 U.S.C. s. 131 (dealing with billboards), s. 1361 (dealing with junkyards), and s. 319 (dealing with landscaping) (1965); the National Wild and Scenic Rivers Act, 16 U.S.C. s.s. 1241-1249 (1968).

[43] See for example; 16 U.S.C. s. 460q-3 (Whiskeytown-Shasta-Trinity National Recreation Area in California); 16 U.S.C. s. 460r-4 (Mount Rodgers National Recreation Area in Virginia); 16 U.S.C. s. 460y-5 (King Range National Conservation Area in California); 16 U.S.C. s. 460p-4 (Spruce Knob-Senecca Rocks National Recreation Area in West Virginia); the National Historic Landmarks Preservation Act, 42 U.S.C., s. 1500d-1 and associated HUD aquisition program, 16 U.S.C. ss. 426-430 (1970).

[44] 42 U.S.C. s. 4321 et seq.

[45] Sierra Club v. Morton, 92 S. Ct. 1361, 405 US 727 (1972).

[46] 441 F.2d 232, 1 ELR 20160 (4th Cir. 1971).

[47] Environmental Defense Fund, Inc. v. Corps of Engineers, 324 F. Supp. 878, 1 ELR 20079 (D.D.C. 1971).

[48] 319 F. Supp. 90, 1 ELR 20045 (W.D. Wash. 1970), 329 F. Supp. 118, 1 ELR 20286 (W.D. Wash. 1971), rev'd, 450 F.2d 1193, 2 ELR 20139 (9th Cir.), 350 F. Supp. 269, 2 ELR 20704 (W.D. Wash.), 350 F. Supp. 287 (W.D. Wash.).

[49] 335 F. Supp. at 1, 1 ELR 20637 (D.D.C. 1971).

Review of Major Progressions and Trends

We can summarize the evolution of aesthetic value treatment by the legal system into a number of significant trends.

1. A shift in emphasis from private action affecting private property (common nuisance) to local public action regulating private property (zoning and architectural controls); public action taking private property (eminent domain); and public action regulating public agency actions and public property (Federal and State Legislation) with some regulation and taking of common trust property (coastal zone, rivers, etc.).
2. A gradual shift of the courts' desires and abilities to face issues with environmental aesthetic values. This shift evolves from not facing the issues, to fictionalizing or masking aesthetics under other issues, and eventually to admitting a procedural right to address aesthetic injury in the anthropocentric sense of the present human user.
3. Both trend 1 and 2 above are dependent upon a highly erratic legal pendulum swinging from conservative to liberal decisions in linear time sequence.

DISCUSSION OF INHERENT PHILOSOPHICAL ISSUES AND EXTRA-LEGAL FACTORS

The following section of the paper is an effort to put the previous legal discussion in a distinctly non-legal perspective. Given the evolution of aesthetic value treatment by the legal system, some major philosophical questions and concepts must be discussed.

Role of Theory and Information

There is a need for more appropriate use of environmental aesthetic theory and methodology, but let us look at how the legal profession has utilized existing theories and methods. A number of lessons can be learned from actual experiences regarding the use of different methods or theories to assess environmental aesthetic values in legal contexts.

An interesting case is the Hells Canyon dams[51] applications. The Presiding Examiner William C. Levy, after noting the requirements of Section 102(2)(C) of NEPA[52] for full treatment and documentation of environmental problems, said of the scenic value of the Canyon:

> Finally, it must be recognized that we can not measure directly in dollars or quantifiable economic terms for purposes of any meaningful comparisons changing environmental scenic values, esthetics, or the loss to future generations of the existing river and its present or prospective uses or values.[53]

Dr. Luna Leopold proposed a method (Leopold and Marchand 1968) to quantify the aesthetic values of the Hells Canyon area in contrast to other riverscapes, but the hearing examiner rejected his attempt saying:

> Dr. Leopold's mathematical formulation of aesthetic values has little application to the choice between a river and a lake and the high 'uniqueness' factor assigned to undesirable as well as desirable features limits its usefulness in license proceedings. The 'unique characteristics of the canyon - narrow valley floors, high adjacent mountains, availability of distant vistas, and little or no urbanization' - exclude the river itself and will continue with or without the proposed development. The surrounding landscape will remain relatively as attractive, unique, and exceptional after development as before.

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[50] See Nolop v. Volpe, 333 F. Supp. 1364, 1 ELR 20617 (D.S.Dak. 1971); La Raza Unida v. Volpe, 337 F. Supp. 221, 1 ELR 20642 (N.D. Cal. 1971); _____F. Supp. _____, 2 ELR 20691 (N.D. Cal. 1972); and Anderson, 1973, p. 31.

[51] Presiding Examiners Initial Decision on Remand, in Pacific Northwest Power Company, Project No. 2243, and Washington Public Power Supply System, Project No. 2273, 1 ELR 30017 (1971).

[52] 42 U.S.C. s. 4332(2)(C) (1970).

[53] 1 ELR 30026-27 (1971).

> However, there will be a substantial increase over present usage.[54]

Regardless of whether one agrees with the examiner's reasoning, he was stating that the quantitative method proposed did not address the issue at hand and was not appropriate given the legal and administrative context of the situation.

Let us switch from quantitative assessment of aesthetic attributes to the opposite pole, i.e., qualitative assessment. A number of expert witnesses were called upon to testify on the aesthetic attributes of Storm King mountain during the historic court case of Scenic Hudson v. F.P.C.[55] The testimony that Sive, counsel for the plaintiffs, thought was most strikingly eloquent (and hence effective) was Professor Scully's:

> It rises like a brown bear out of the river, a dome of living granite, swelling with animal power. It is not picturesque in the softer sense of the word but awesome, a primitive embodiment of the energies of the earth. It makes the character of wild nature physically visible in monumental form. As such it strongly reminds me of some of the natural formations which marked sacred sites in Greece and signal the presence of the Gods; it recalls Lerna in Argolis, for example, where Herakles fought the Hydra, and various sites of Artemis and Aphrodite where the mother of the beasts rises savagely out of the water. While Breakneck Ridge across the river resembles the winged hill of tilted strata that looms into the gulf of Corinth near Calydon.[56]

Sive's strategy in using testimony such as this was to persuade the court that the aesthetic qualities of Storm King were so great that any diminishing of these qualities would leave society without these values (1970:1186-7). The second part of the strategy was to establish the uniqueness of Storm King at a par equal to landscapes such as national parks and monuments which would then be recognized as beyond any claims for use for power development or other industrial purposes. Thus we have between Leopold and Scully a complete range of type of information or method from highly quantitative to highly qualitative. Which is more appropriate?

The information or method must be appropriate to the context at hand. In keeping with many of the legal contextual tests and rules used in environmental aesthetics cases, there should be a contextual theory for use of environmental aesthetic information and methods. Such a theory has been proposed by Pepper (1937), an aesthetics philosopher. Pepper's contextualistic theory combines and allows for both qualitative and quantitative approaches to aesthetic appraisal.

Another possible approach is to utilize environmental psychology testing methods to ascertain the agreement levels of meanings of legal terms and criteria. Such an approach has been proposed for visual management of the Wild and Scenic Rivers (Smardon 1977); the California Coastal Zone (Wohwill 1978); and the Clean Air Act Amendments of 1977 (Craik 1979). In summary, environmental aesthetic information or theory application should not be done in isolation from the legal context, but in a complementary fashion.

Substantive vs Procedural Emphasis

Most of the issues discussed concerning aesthetics and the law have been procedural rather than substantive. This is probably as it should be. We do find judges trying to develop substantive tests and concepts concerning environmental aesthetics, such as "visual occupancy," "sensitivities of the average man," etc. We also find that legislation, such as the National Forest Management Act[57] and the Federal Land Policy and Management Act,[58] is becoming more specific as to how aesthetics is to be considered in environmental planning activities. This may mean that courts may get into more substantive issues if they do "fact finding" to see if agencies have done what the laws and regulations say they should be doing. This potential trend in substantive involvement by the legislatures and the courts may be problematic in that agency operational flexibility may be impaired or constrained. It also puts an impetus on the agencies to stay "one step ahead" by doing their homework in developing sound administrative procedures and substantive methods.

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[54] 1 ELR 30026-27 (1971).

[55] Scenic Hudson Preservation Conference v. F.P.C., 354 F.2d 608, 620 (2d Cir. 1965), cert. denied, 384 U.S. 941 (1966).(Licensing for proposed pump storage power plant at Storm King New York).

[56] Record at 4888-89, In re Consolidated Edison Co. of New York, Inc. Project No. 2338 (F.P.C. 1967).

[57] 16 U.S.C. s. 600 et seq. (1976).

[58] 43 U.S.C. s. 1701 et seq. (1976).

SUMMARY, FUTURE IMPLICATIONS AND DIRECTIONS

In summary public regulation and control through legislative mandate for the public environment and, on a more limited extent, for the private environment seem to be the most hopeful prescription for environmental aesthetics. In assessing the roles of the different actors in environmental aesthetic control a number of conclusions could be drawn.

Judges, legislatures and administrative agencies need to make better use of existing aesthetic theory and information so that theoretically compatible approaches are developed for environmental aesthetic protection. Many of the legal tests are of a contextual nature (Smardon 1978) and there is a corresponding contextual theory of aesthetics (Pepper 1937). Both could reinforce each other. Legal professionals need to work with landscape architects, planners, and social scientists and vice-versa. There needs to be a "meeting of the minds" over environmental aesthetics. If this happens better theory will be provided for legal test foundations, there will be a more orderly and rapid evolution of aesthetics and law, and methodologists will be confronted with more realistic environmental aesthetic questions and dilemmas.

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Landscape Values in Public Decisions[1]

Richard N.L. Andrews[2]

Abstract: The National Environmental Policy Act requires all agencies to develop techniques to insure appropriate consideration of all environmental amenities and values, including those presently unquantified, by all federal agencies in all their activities. These obviously include the values associated with the landscape and its visual resources. The visual resource, however, is inseparably intertwined with people's prior experiences and expectations, as well as nonvisual dimensions of experience; and its values include not only preferences but also cultural norms and ecological functions. Many valuable techniques have been developed for visual resource management, especially recent ones which move beyond traditional inventories of landscape characteristics and attempt to identify perceptual preferences; but much remains to be done. Comparative analysis of existing techniques in case studies would be fruitful, as well as more attention to (1) relationships between preferences, cultural norms and the landscape's ecological functions, (2) relationships between people's preferences and their knowledge and expectations of the landscape, (3) holistic approaches to landscape analysis and management, and (4) wider dissemination and use of existing methods within existing permissive statutes.

INTRODUCTION

How can the values of the landscape as visual resource be integrated into public decisions? In some cases, the law provides a clear basis for analyzing and managing these values (Cerny 1974, Smardon 1978). In others, however, the law does not specifically cover all the landscape values that are at stake. In these cases, probably the great majority of decisions, the administrator must somehow decide what to do about landscape values -- whether to invest in analyzing them, how to characterize and measure them, how heavily to weigh them in his decisions -- and how to justify those decisions. This paper, therefore, asks how the techniques of landscape researchers, both academic and applied, can meet the needs of landscape management decision processes.

There is, in fact, a statutory requirement which both permits and directs the treatment of landscape values, at least by federal administrators, in all their decisions. The National Environmental Policy Act[3] is best known for its requirement of detailed statements of environmental impact for all major federal actions that may significantly affect the quality of the human environment (Section 102[2][C]). It is also known to some for its requirement that agencies make integrated use of the natural and social sciences and the environmental design arts (Section 102[2][A]); and for its substantive mandate, in Section 101(b), to "assure for all Americans...esthetically and culturally pleasing surroundings." Less well known, but equally explicit, is the clause which directly precedes the EIS requirement - Section 102[2][B] - which states as follows:

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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[3] The National Environmental Policy Act of 1969, 42 U.S.C. 4321 *et seq*.

> To the fullest extent possible... All agencies of the Federal Government shall...Identify methods and procedures, in consultation with the Council on Environmental Quality established by Title II of this Act, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision-making along with economic and technical considerations.

In ten years since NEPA was enacted, no agency has formally implemented this charge, although many do of course use *some* methods for considering *some* environmental amenities and values. Whatever any other law may say about particular aesthetic values, however, this one clearly authorizes agencies both to use and to develop techniques, to *insure* consideration of environmental amenities and values in their decisions, even - and especially - those that are often considered difficult to quantify, such as the values of the visual resource. It is applicable to all federal agencies; it is applicable to all their actions - unlike EIS's, not just "major" actions that may have "significant" impacts -; and most important, it extends to all environmental amenities and values, not just a few specific ones as in the Clean Air Act and Federal Water Pollution Control Act.

For the purposes of this paper, therefore, this statutory mandate also provides a useful frame of reference in which to consider how landscape analysis and management techniques can be applied to landscape management decisions. It requires answers to three questions:

1. What are the landscape amenities and values that should be considered?
2. What methods and techniques can be used to insure that these values are appropriately considered in decisions--what is the present state of the art?
3. What improvements in technique do managers need developed that the state of the art is not now providing?

LANDSCAPE VALUES

What are landscape amenities and values? One tradition of landscape research defines them by inventorying observable characteristics of the landscape, such as form, spatial definition, light, distance, observer position, and compositional type (Litton 1968), and then postulates aesthetic principles as to what relationships among these characteristics are considered most desirable (U.S. Forest Service 1973:2). These approaches typically assume that certain landscape values are commonly agreed upon, and identifiable, by the observation and judgment of experts.

Where the first tradition assumes value consensus and directs its attention to landscape inventory, the second, and more recent tradition focuses instead on the discovery of people's preferences. It starts from the premise that people's preferences differ - by class and culture, age, and experience, for instance - and that the expert may not know nor understand these differences without asking. This tradition therefore directs its attention to the landscape's observers, and seeks to identify - with their involvement and help - what the landscape's values and amenities are to them (e.g. Daniel and Boster 1976).

It is important to recognize, however, that the landscape's values include more than preferences (Andrews and Waits 1978). A landscape may be valued by an individual in the sense that s/he likes it, or likes it better than others - thus the study of values as preferences. But it may also be valued by a society or culture whether or not a particular individual or group prefers it. Landscapes protected by law are obvious examples - such as national parks and historic neighborhoods - because laws in principle express the *society's* enduring values, its norms, not just the preferences of individuals. Individually we might each prefer to discard our litter where we camp; collectively, however, we pass and generally respect laws to pack it out with us. Individual's preferences also are heavily influenced by culturally transmitted images and norms (Lee 1978, Tuan 1974). In this sense values include not only individual preferences, but also cultural expectations, which underlie and sometimes disagree with individual preferences, and are often far longer lived. The values associated with natural landscapes in America, for instance, may often be expressed through preference statements, but actually are embedded in deeper and much longer-lived, culturally transmitted, patterns of societal norms.

Finally, a landscape is valuable for what it does rather than just for how people feel about it - for its *ecological functions* as well as its appearance and cultural meaning. Wetlands, for instance, are a type of landscape that has negative visual connotations for many people, and a negative set of cultural norms attached to it as well - useless swamps, mosquito breeding grounds, nuisance, waste lands, needing to be drained and put to productive use - yet this landscape also serves uniquely important ecological functions, such as purifying streams and producing fish and wildlife, whether or not humans fully recognize them. In such cases, appropriate management may require modification of our preferences and norms to fit the landscape's ecological values, rather than modification of the landscape to fit our inadequately informed preferences and norms.

The distinctions among these different meanings of "landscape values" -- preferences, norms, and ecological functions - are important to understanding how such values can be integrated into administrative decisions. The value of a forested hillside for timber production, for instance, can be only partially measured by asking people's preferences. Neither does this ecological or economic potential nor preferences alone necessarily capture all the relevant social norms for deciding whether it should be preserved or cut. Yet landscape managers often fail to make this distinction, and as a result ignore or misconstrue some of the landscape values that are affected by their decisions.

An anecdote will perhaps make the point even more clearly. In one state some years ago, a survey found strong consensus among people's perceptions of the state's most attractive natural river, a clear-running mountain brook. Biological analysis, however, revealed that the reason for its clarity was serious contamination by acid mine drainage, which had suppressed all biological life in it. For which of its values, therefore, should this stream landscape be managed - its visual attractiveness or its ecological health? Neither visual preferences nor ecological analysis alone provide the answer. What is needed is a deliberate information sharing process for resource decisionmaking, within which the relationships among preferences, norms, and ecological functions can be clearly developed and refined as a basis for decisions.

In short, the landscape has several sorts of values. All of these are intertwined with people's perceptions and preferences, and all need to be considered in landscape management decisions. But many of them cannot be discovered by looking at visual preferences alone. The values of the landscape as a whole, and even of the visual resource aspects of the landscape, include not only expressed preferences but also cultural norms and its ecological functions.

APPROPRIATE CONSIDERATION

What methods and techniques can be used to insure that these values are appropriately considered in landscape management decisions? In principle, appropriate consideration of landscape values has four rather specific criteria. First, such values must at least be explicitly identified, including not only individual preferences but also cultural norms and ecological functions of the landscape. Second, they must be expressed in terms of valid indicators, measurements, and inferences. Third, they must be meshed with the process of planning and decisio making, so that they serve not only to justify or mitigate choices already made, but also as points of comparison among alternative actions. And finally, they must be given appropriate weight - however that weight may be defined - relative to other considerations in the decisio To insure appropriate consideration, techniques are needed to fulfill all four of these criteri

Preferences, Expectations, and Information

Present techniques heavily emphasize eithe the inventory of landscape features that match people's assumed preferences, or the identification of people's preferences for particular lan scape characteristics (Cerny 1974, Anderson 1978). Some research has also been done on personality background factors affecting people's preferences (e.g. Craik 1969, McKechnie 1974); and a few researchers have begun to address the cultural bases for people's preferences, and the norms implied by group preferences (e.g., Anders 1978). Others, however, ask only such questions as how much people would be willing to pay for preserved (or altered) landscape, without ascertaining the cultural assumptions behind the answers; or they infer preferences from the observations of people's behavior without examining the sensitivity of that behavior to constraints (Andrews and Waits 1978). In agency practice, a landscape values study may often mean simply a crude survey of present users' likes and dislikes, ignoring normative assumptions and ecological functions (and often even the preference of potential users).

There are also important questions even within the realm of preferences that today's techniques only begin to address. For example, people's preferences are shaped not only by thei immediate perceptions, but also by their prior experience, knowledge, and expectations (Clay 1958, Kaplan 1978). Over ninety percent of Americans today live in urban rather than rural areas, and the vast majority of them is at least relatively ignorant of the processes going on in the landscapes seen - both the natural processes, such as hydrologic flows and ecological communities, and the human processes of natural resource production, such as forestry and mining.

If vacationing suburbanites expect to see unbroken forest and instead see a clearcut, therefore, their initial perception is quite likely to be simply that it is ugly and intrusive (cf. Radar 1971, Schweitzer et al. 1976). Their perception of the forest, too, is unlikely to pick up many features that actually result from previous human activities - such as grassy clearings and brushy edges resulting from earlier logging. But would they respond in the same ways if they had more information to guide their expectations, such as interpretive materials on forest regeneration over time? They still might not always agree with the manager, particularly if the place had a particular symbolic meaning to them in its pristine condition. But at least their preferences would be based on a richer understanding of the relationship between their perceptions and preferences towards the landscape, on the one hand, and on the other, the landscape processes and functions that underlie what is seen.

Equally important, relatively little attention has so far been directed to landscape managers' perceptions and expectations of the resources they manage. Which of these are based on their knowledge of the landscape's functions, and which simply on their own personal preferences, or agency traditions, or clients' goals? Natural resource management professionals may understand many ecological and economic potentials of the landscape better than most laymen, but they also carry preferences and norms which may differ considerably from those of the general public. (O'Riordan 1971: 105-108; USEPA 1973b). They may be no less ignorant of the landscape values, needs, and expectations of urban populations than these populations are of the landscape; and they too, therefore, could benefit from better information to shape their expectations.

In short, there is both a serious need, and a valuable opportunity, to reduce the role of mismatched expectations in landscape management values conflicts. Sometimes it is the viewer's expectation of the landscape that is mismatched, based on inadequate experience or information; in these cases better preparation or interpretation by landscape managers might help. In other cases it may be the manager's expectations of the viewer that are mismatched; in these cases the manager may be the one who needs to learn and adapt to new social perceptions, preferences, and norms. In all cases, however, current techniques do not yet tell landscape managers enough about ordinary people's understanding of the landscape, about their own understanding of people's landscape values, and about the educability of either of these expectations if more information and interpretation were integrated into management activities.

General Principles and Particular Places

A characteristic shared by many present techniques is a reductionist approach to the study of landscape values. That is, many techniques seek to break up the landscape into separable characteristics that can be identified individually and then recombined - for instance, by weighting - so that in principle the techniques could produce a consistent set of general rules for assigning values applicable to large numbers of landscapes (cf. U.S. Forest Service 1973). If they are successful, the benefits for managers are obvious. But should all landscapes - or even all landscapes of a particular type - be managed by the same set of principles?

Charles Little (1979) suggests that there is a growing divergence between the landscape values capable of being easily rationalized as public policy, and those associated with actual personal perception. To the extent that our purpose is to protect the sense of value which people experience in the landscape, is that purpose best served by the present emphasis on reducing it to characteristics that can be inventoried, and applied uniformly to different regions and places; or should additional effort be devoted, for instance, to more holistic concepts of landscapes; perhaps to more idiosyncratic composite images that comprise particular places, rather than to general principles that can be transferred as regulations to all places?

Fred Bosselman (1979), too, has recently argued that what is most important about landscapes is their "specialness" rather than their generalizable qualities, the sense of special place that people can experience while in one that they cannot experience in other places. Each national park, for instance, is established and managed under its own unique statute, not under a homogeneous set of system-wide rules - because each was set aside for its own particular qualities, not for common ones. The same sense of place is found in other places that people prefer - it is their specialness as whole places, not their generalizable characteristics, that make them preferred (cf. also Leopold 1966). Bosselman argues therefore that the goal of management should be to enhance the special qualities of each landscape as an individual place, rather than to develop uniform rules for all places.

Kevin Lynch (1976), similarly, in a recent and stimulating essay, argues for managing the "sense of a region," by which he means the quality of particular places as people experience them. People sense places on a very local scale, Lynch argues, and experience them in regional patterns or images. They experience them, moreover, not only with sight but with all their senses - hearing, taste, smell, touch as well. The quality of a place is made up of patterns of these sensations embedded in their experience and expectations. Landscape management, therefore, should include far more attention to the sensory qualities of individual places and regions, and to the effects of those qualities on people's experience and well-being.

If these three views are correct, more effort is needed to discover and characterize the holistic qualities of individual places and guide the management of them. It is quite likely that some of today's techniques for preference analysis could be extended to serve this purpose: in a sense this task is far simpler than attempting to define general principles for large numbers of landscapes. Others might fruitfully arise out of greater cross-fertilization between public lands-oriented landscape research and the even larger parallel tradition of work on urban landscapes (Lynch 1976). Still others might require new and different approaches. All would require greater emphasis on understanding the meaning of particular places to people who experience them, rather than on abstract or generalized methodologies for making landscape design decisions.

It is important to emphasize that this is not an argument for singling out "unique" places for special attention. The national landscape does have many unique places, some unique in their beauty and others in their ugliness. So do cities. The need is to recognize and respect the special sensory qualities, the particular aesthetic potentials, of every place - the public lands and forests as well as the national parks and monuments, the daily places of people's lives and work as well as the national lands where they recreate.

Comparative Analysis

A final comment on the current state of the art is that there has so far been little comparative analysis of the different techniques that are available (Andrews and Waits 1978). This problem has been noted by others as well: Cerny (1974:244), for instance, comments that most techniques have been applied only by their originators. Even vocabulary may vary considerably from one technique to another, without consensual definitions of many evocative terms and metaphors used to characterize people's perceptions. It is extremely difficult, therefore, to evaluate the usefulness of alternative techniques to landscape managers, or even to know whether different techniques are likely to yield consistent results - and if they do not, which (if either) is "correct." This subject clearly needs more attention from the research communit perhaps by applying several techniques to common case studies and comparing the results.

ANSWERS AND QUESTIONS

What improvements in technique, therefore, do landscape managers need to insure "appropriate consideration" of landscape amenities and values, that the state of the art may not now provide? Some answers to this question have already been suggested above. One is additiona attention to the relationships between people's preferences and cultural norms, and between both of these and the landscape's ecological functions. A second is more attention to the relationships between people's preferences and their knowledge and expectations of the landscape - including those of landscape managers - and to their responsiveness to additional information. A third is the development of holistic approaches to the values people experience in particular landscapes, and comparison of these approaches with existing techniques - as well as comparative analysis among existing techniques themselves, and especially, better fusing of experience between research on wildlands and on urban landscapes.

To these I would add three more. First, in developing and improving its techniques, the research community needs better information about how landscape managers actually perceive and use their results. What kinds of information are actually used in decisions, and what serves mainly just to rationalize decisions already made? What do managers not now know that they wish they did, that new techniques could provide? Which techniques actually worke in practice, which did not, and why? The answers to such questions are sometimes disappointing, but they are indispensable to further progress.

Second, landscape managers could be acting much more vigorously to incorporate landscape values, and aesthetic considerations generally, under existing laws. NEPA contains three claus that require this, and the new regulations of the Council on Environmental Quality explicitly require discussion of unquantified or qualitati impacts on environmental amenities and values.[4] Numerous statutes contain more specific requirements for the consideration of particular aesthetic concerns. These issues are frequently ignored or discounted, however - perhaps out of an unfortunate assumption that aesthetic concern are luxuries rather than essentials or that they are purely subjective matters of taste that cannot be objectively justified (Bufford 1973). Many agencies also fail even to make use of existing methods for consideration of landscape values, let alone to reach beyond them; many planners so far lack informed awareness of the tools and methods that are available to them (USEPA 1973). Wider dissemination and testing of existing methods is clearly in order.

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[4] 43 Federal Register 55997 (November 29, 197 § 1502.23.

Finally, increased attention is needed to aesthetics in people's everyday environments, rather than merely in highway design and public lands management. Far more Americans' experience is of necessity in urban and suburban places than in the public lands and highways where they recreate; it would be unfortunate if our primary emphasis in research were heavily concentrated only on the latter.

Existing laws already permit far more vigorous protection of the landscape's visual resources than is generally practiced by most government agencies. What is too often lacking is simply a real understanding and concern for the visual landscape, an imaginative approach to the identification of alternatives for it, and the effective political leadership and will on the part of landscape managers to protect it. The most fundamental issue, therefore, is not the particular methods and techniques by which landscape values are characterized - though these methods can and must continue to improve - but getting those values more fully represented and more seriously considered, by whatever legitimate means, in the public and corporate decisions that affect them. If their significance is recognized, improvements in analysis can easily continue. If their significance continues to be discounted in decisions, however, improvements in analysis alone may be of little help.

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Visual Quality Testimony in an Adversary Setting[1]

Bruce H. Murray and Bernard J. Niemann, Jr.[2]

Abstract: This paper documents the conditions, procedures, techniques and conclusions under which a utility was required to replace two-thirds of a mile segment of overhead 69 kv transmission line passing an Ice Age National Scientific Reserve with underground at the cost of $950,000 vs. $60,000 for overhead (WPSC 1978). Because the proposed right-of-way would not, in this case, create deleterious impact to other aspects of the environment, e.g., soil erosion, vegetation removal, etc.; therefore, the sole issue became whether the overhead transmission line would deleteriously alter the visual quality of the Reserve. The paper focuses upon the authors' experience as expert witnesses in this adversary setting and provides specific insights into how the case was developed, presented and sustained. The primary purpose of this paper is to share this experience with others who are concerned with the visual resource.

BACKGROUND

The results and conclusions reached by the Wisconsin Public Service Commission (PSCW) proved to be of value to those concerned with the visual resource. During the preparation of the case, we were unable to find published relevant material from which to assist us. The intent of this paper is to share our experience, the techniques we employed, plus reasons for our approach with those of you who may be in similar situations.

CONDITIONS SURROUNDING THE CASE

The construction of a 69 kv transmission line in contrast to larger transmission lines, e.g., 345 kv, is typically not a controversial locational item. Nor, would it normally be expected that a facility of this type would attract institutional, legal and professional interest. This was not the situation in this PSCW case. The reasons for the interest in this case are important because they establish a set of opportunistic conditions for a test of the importance of visual quality. The test being - under what conditions would the PSCW commissioners be willing to rule for or against construction of a transmission facility solely on visual quality issues?

The following conditions were present. First, we as professionals, were asked by an attorney representing a private land owner to visit the site. We responded to two questions.

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[1] Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resources, Incline Village, Nevada, April 23-25, 1979.

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One, if construction of the 69 kv line were to be completed, could there be a deleterious visual impact to the Cross Plains segment of the Reserve? Second, was the PSCW staff in error by not requiring an environmental impact statement because the Wisconsin Environment Policy Act (WEPA) requires a two-step evaluation? The first step requires the agency staff to determine if a more comprehensive environmental impact statement is necessary. In this case the PSCW staff determined that an environmental impact statement was not necessary.

Second, the institutional and political conditions within the PSCW appeared to be supportive of a test case. The PSCW chairman is a nationally-known energy economist recognized for his innovative use of economics in resource related issues plus he had conducted research on economics in relation to environmental values. Third, two competent, aggressive, and committed attorneys were involved. Previous experiences in adversary settings had proven to be extremely counter-productive when the authors had been involved or represented by inferior and non-involved counsel.

The adjacent land owner was represented by a tax attorney who typically represents settlement cases. The citizens of the State of Wisconsin were represented by the Public Intervenor, which is a public supported office. The responsibility of the office is to intervene when the citizens' rights to environmental quality are not being represented by the Department of Natural Resources. Before becoming the Public Intervenor, he was an aggressive criminal lawyer in the Attorney General's office. Fourth, the geological uniqueness of the site would make the case for visual quality more straightforward. From a geological point of view the site is unique (Black). Fifth, our previous experiences in developing weighted, descriptive and hierarchical transmission location models show that an array of experts concur that unique natural features should be avoided (Murray and Tsao 1973, Murray and Niemann 1974, Niemann 1973). The results of the three studies indicate that there is considerable agreement that for visual quality reasons unique natural areas should be avoided. All of these studies have documented the following: 1) avoid areas of recognized national importance, 2) avoid scientific areas, 3) avoid significant scenic views, 4) avoid unique archeological and historic features, 5) avoid scenic roads, 6) avoid ridge lines, 7) avoid unique topographic features, and 8) avoid unique geological formations. Also, because one of the studies had involved the utility proposing the construction of the 69 kv transmission facility, it seemed appropriate to determine that the previous conclusions would be admissable and prevail in an adversary setting. Sixth, there were additional conditions which made this a compelling situation. The PSCW staff had erred, in our judgment, in not requiring an environmental impact statement. This, therefore, made the conclusions and recommendations for non-undergrounding suspect. The utility had chosen a highly visible site (the highest point in the region) for the substation which was eventually shown to be insensitive to overall visual concerns. In addition, it was generally concluded that the utility had chosen their route only after being threatened with legal action. It was not their preferred route. Neither the utility nor the PSCW had asked the Department of Natural Resources (DNR)(who manage the Reserve) for their opinion concerning the proposed 69 kv transmission facility. Also, the employee responsible for overall planning of the Reserve system in Wisconsin was not allowed by his superior to speak out on this issue. This constraint for basically political reasons suppressed public discussion of this visual quality question.

CONDITIONS OF THE SITE

The Reserve was created in May 1974 (National Park Service July 1973). The enacting legislation provided for a joint planning, management, and ownership arrangement between the National Park Service (NPS) and the DNR. The nine reserve sites were selected to represent different results caused by the glacial period in Wisconsin. The Cross Plains unit is an 160-acre site that includes a unique gorge which was created by melt water from the melting glacial ice. The regional condition makes the site unique. The site is located on the interface between the unglaciated (driftless) and glaciated landscape. The site is elevated and provides views of both the glaciated and non-glaciated landscape.

The master plan calls for a self-guiding interpretive center and trails. The trails are intended to guide the visitor to the internal plus external glaciation features. The master plan calls for the interpretive center to be located on the top of the site. DNR was unable to purchase this site and politically did not want to ask the state legislature for permission to use its condemnation authority. This will require development of the interpretive center in a different location. The location would be visually much closer to the proposed 69 kv transmission line. This becomes an important issue in the case.

PRODCEDURE

Objectives of the Overall Procedure

In this section we will describe the procedure and techniques we employed and the overall objectives. Four objectives were utilized to assist and guide the development of the case materials. They are as follows:

Defensible--The materials and techniques employed had to be able to withstand cross-examination. The techniques and resultant materials could not be construed as biased, arbitrary, or irrelevant.

Factual--The data presented had to be factual. Interpretations and expert opinion had to be clearly identified and limited to the findings portion of the case.

Self-Descriptive and Logical in Progression--The case materials had to be developed and organized in such a way that the contents lead the reviewer logically through the materials in a self-describing format. We assumed that the PSCW staff, the utilities, and the PSCW commissioners would review the materials in detail in private. Because the materials laid the foundation for our eventual findings as expert witnesses, we developed the materials to assist the self-reviewer to understand the basis for our conclusions.

Illustrative--In addition to being self-descriptive and logical, the materials needed to be illustrative as much as possible to stimulate the before and after conditions of the 69 kv transmission facility. The utilities were inadvertently quite helpful in assisting us simulate the before and after conditions. As soon as we knew we were going to be involved, we photographed the site. The utility was quite sure they would eventually be allowed to construct the facility, so they proceeded to construct the facility. We then again photographed the site. The presence of structures provided us with real and not simulated before and after conditions. Five guidelines were utilized in preparing the case materials. The presentation graphics were: visually communicative, flexible, interrelatable, attractive, and concise. These objectives were incorporated into the exhibit materials represented in figure 1.

We now list the variables selected and the reasons for their selection. Figure 2 illustrates the dimensions of the Reserve, the difference between authorized and actual public ownership and the proposed transmission alignment. Areas within the dashed line are presently owned by DNR. Figure 2 also serves as a factual base for illustrating the following features.

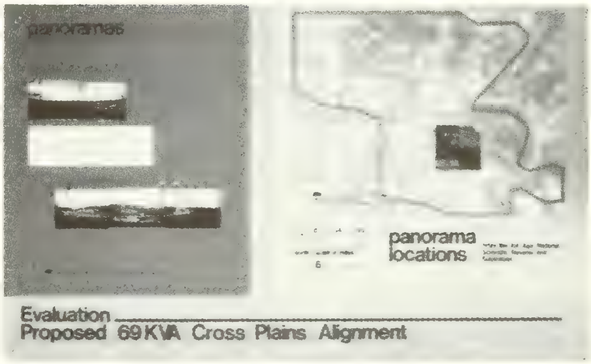

Figure 1-- Panel Exhibit

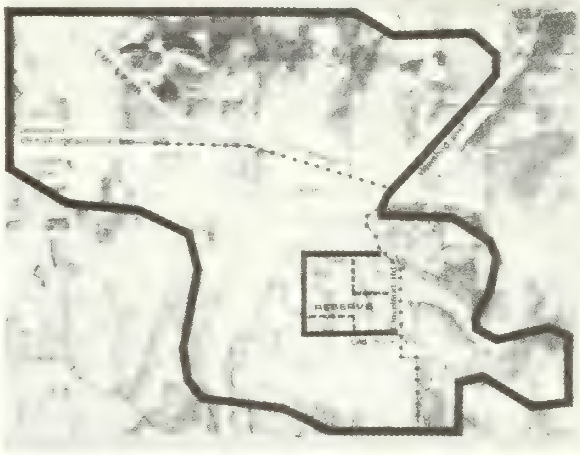

Figure 2 -- Photographic Base Map

Viewshed--(see fig. 2). Because one of the primary functions of the site is to provide views of the glaciated and non-glaciated landscape, it was important to document factually the extent that it is possible to view both landscapes from the site (heaviest line).

Proposed and Existing 69 kv Transmission Route--(see fig. 2). The inclusion of all existing 69 kv systems (line with dots) is important to document the extent and the distances from which these facilities can be seen from the site.

Associated Landscape Features--(see fig. 2). Relevant associated features were identified such as adjacent land uses. These were indicated to document our familiarity with the site.

Topography--The portrayal of this variable was important for three reasons. One, it documents that the substation, to which the 69 kv transmission system connects, is located on a prominent and highly visual elevation. Two, the Reserve site is located on a prominent elevation overlooking two distinct geologic landscapes. Three, the delineation of the viewshed which is shown on the photographic mosaic base can be verified if desired.

Land Ownership--This variable was included for three reasons. One, it was used to verify that DNR owned only portions of the totally authorized area. Two, it was used to document overall ownership patterns. Three, it was used to document that, as expert witnesses, we were aware of the private litigant's property holdings. We anticipated that the utility would attempt to cloud or discredit our objectivity as expert witnesses by implying that the adjacent land owner was only looking out after his own long-term potential development interests and not necessarily the public good. As anticipated, the utility did raise the implication. We responded by referring to this document.

Open-Space Corridor--This variable was included to show that the Reserve site was originally designated as an open-space corridor. It reinforced the concept that the Reserve site had special qualities which could possibly be altered by visual intrusions.

Photographic Locations--A series of before and after photographs were taken from the Reserve, to the Reserve, plus along Cleveland Road which parallels the route of the proposed 69 kv transmission line. The location and direction of each photograph was recorded. If the photograph was used in the quantitative change analysis it was so noted. We anticipated that the objectivity and representativeness of the photograph would be questioned. This proved to be true. The inclusion of this plate was quite important in illustrating the representativeness of the photography.

Panorama Locations--To assist further in illustrating the photographic coverage, the panorama photographs were noted. This variable was included to document the location of the scene and cone of visual coverage of each panorama. In addition, with the use of other overlay variables, the type of landscape elements which are visible in the panorama could be verified.

View Locations with Comments--At this point in the case the type of information changes. The preceding material was straightforward and did not require professional or expert witness interpretation. The materials which follow do. This set of materials includes the before and after photographs taken from the site with comments. The comments are our reactions, as experts, to visual change resulting from the proposed 69 kv transmission line. The comments were also used to verify again what features were visible from the Reserve.

Quantitative Changes--This variable was used to document and verify the type and quantity of landscape elements which are presently visible and the type and quantity of landscape elements potentially visible after the construction of the proposed 69 kv transmission line (Murray 1973). The results of this analysis indicate that construction of the proposed 69 kv transmission line would introduce new visual elements to the landscape. From our experience, it is important to document clearly that visual change will occur. How visually perceptible the change will be or what effect the change will have are separate questions. What is presented for hearing record is that change will, in fact, occur. A non-verified theory was utilized. A "cobweb theory" was developed and applied to measure visual change, the assumption being that the combination of conductors created a "cobweb" effect between the viewer and the scene; the net visual change therefore being equal to the distance between the top and the bottom conductor. The utility attorney argued to the contrary which was that the net visual change was only equal to the net perceptual diameter of the conductor itself.

Photographic Sequence Along Cleveland Road with Comments--Cleveland Road is important because it will serve as the entrance road to the interpretive center and the visitor parking lot.

Proposed Tour Route: Effect of Utility System Traveling North with Comments--This material was included because the interpretive tour route is an official part of the master plan. Travel along the Interpretive Tour Route is potentially affected by the 69 kv transmission line itself and by the connecting substation. For example, emanating from the substation is a series of distribution lines. These distribution lines parallel the Interpretive Tour Route and associated glacial features observable from the route.

Techniques Employed

Discussions were included in the previous two subsections about the source and content of the base materials. What follows is a discussion of the techniques which were employed to insure that the base materials would be accepted as relevant material. As separate techniques they are not that unusual, but as a composite group they represent the array of techniques which were needed in this adversary setting. The following techniques were employed:

Site Visit--Familiarity with the site was essential. For example, the PSCW staff had never visited the site even though it was in close proximity to their office. In addition, the utilities' attorney was not familiar with the unique qualities of the site. More familiarity with the site proved to be of considerable advantage - particularly of a psychological advantage when the expert lacks experience in an adversary setting.

Logical Sequence of Base Materials--The use of overlays and a common set of scales plus a pre-ordered sequence proved to be very helpful. Knowing that the material was self-guiding provided a psychological lift during the more intense periods.

Graphic/Overlay Procedure--To assist in the conveyance of the content of the base materials, various graphic and overlay techniques were employed. Also the base materials were self-contained and displayable on a mounted panel. All photographs were securely mounted on panels therefore requiring others to review the materials in the relationship with the testimony.

Random Photography--Because we anticipated the utilities' attorney would question the representativeness and objectivity of our photography, we employed a random photographic procedure along Cleveland Road. The technique employed consisted of segmenting the road into 100 foot segments. Numbered coins representing 10 foot intervals were used to assign randomly the photographic location within each 100 foot segment. Our concern over non-biased photography proved to be very important. For example, as anticipated, the utilities' attorney asserted that the photography was purposely taken to portray only the negative aspects of the 69 kv transmission line. In addition, the attorney argued that "artists' license" was used to accentuate further the negative aspects. Because we anticipated this form of cross-examination, we were able to respond effectively. It was essential for us to prevail at this point in the testimony. The photographs were an essential part of the case. If they had been discredited, our case would have been severely hampered.

Before and After Photography--Because we were able actually to photograph before and after conditions, the task of simulating the 69 kv transmission line was quite easy. The importance of representative simulation cannot be underestimated in an adversary setting.

Quantitative Measurement of Change--This technique consisted of projecting a 35 mm slide upon a grid. The technique was patterned after that developed by Murray (Murray 1970). Within each square, the presence of man-made features was measured in percent. This procedure was conducted for selected before and after photographs. The accumulated cell differences between the before photograph and the after photograph equal the quantitative measurement of change.

Documentation--Again, to ensure that our base materials would be admissable, we very carefully documented their origins and currency. All maps were documented as to origin, date and original and actual scale. The location and direction of all photographs were maintained. The type of film, type of camera, type of film processing, type of lens, characteristics of the lens, time of day, and the date of the year were also recorded.

Experience and the Adversary Mentality--The experiences that we have had indicate quite clearly that anticipation, preparation, documentation and a sort of "gamesmanship" are important factors. The adversary setting in which the primary goal of the adversary is to discredit you as an expert is painful. It is particularly painful to the uninitiated who tend to react as if the cross examination is meant personally. In law classes the "art of selecting and using an expert witness" is discussed and taught. Unfortunately, the education of design professionals is void of preparation in the art and science of being an expert witness. Success in these adversary settings is important. It is professionally important to perform well to ensure that your client has been represented effectively. Quite simply, success builds a reputation and credentials as an expert which lawyers and the courts consider fundamental.

Rehearsal--Some form of "dress rehearsal" in which you and your lawyer develop the questions upon which you will give your testimony is essential. In addition, the lawyer can assist by asking questions expected during the cross examination from the adversary and you can assist the lawyer by developing questions to be asked of the adversaries' witnesses. Since most lawyers will have had no prior experience in visual quality contested cases, you will be expected (most likely) to provide the basic strategy. Be aware of other cases which are relevant and be familiar with the related body of knowledge. The expectations of an expert witness are just what the term implies - an expert.

Utility Insensitive to Public Interest

The quality of the views from the Interpretive Tour Route to the pro-glacial lakes and the unglaciated landscape were adversely affected by the poles and lines.

The substation was located on the highest elevation in the area near the Reserve resulting in a visible and incongruous visual object.

The utility proposed erecting 69 kv lines adjacent to the Reserve creating a situation deleterious to the visual quality of the Reserve.

The utility had constructed a 69 kv transmission line in the background adjacent to highway 14 creating a visual condition that is deleterious to the visual quality of the Reserve.

Utility Did Not Consider Alternate Routes

The location of a substation does strongly influence the route selected for a transmission line. In this case there were several alternate routes that would have avoided the Reserve.

PSCW Staff Should Have Required an Environmental Impact Statement

The project was evaluated by the PSCW staff utilizing this procedure and in the word of a PSCW staff member, it was concluded that "...the overall difference in impacts between routes is not environmentally significant." (PSCW 1977, p. 5).

This conclusion, by PSCW staff, in our opinion was not justified on the face of the evidence provided.

Lack of PSCW Competence in Visual Resource Evaluation

In our judgment, the PSCW lacks educational background and competence in visual quality assessment.

Utilities Ignored Previous Research Findings

The information was known, and, presumably understood by the utility, but staff members chose to ignore the information when locating the transmission line adjacent to the Reserve.

RECOMMENDATIONS

From the analysis we carried out, the following recommendation was given (PSCW 1977, p. 95-96):

> Relocate or underground the proposed 69 kv transmission facility from where the Reserve is first visible from Cleveland Road (traveling south) to where the vegetation begins to mask the proposed transmission facility. The northerly burial point must be predicated upon the location of the interpretive center and the views from the potential interpretive hiking trails within the Reserve. This assures the DNR essential flexibility in determining the most representative and educational hiking trail experience for the visitor. This also provides essential flexibility in determining the location of the interpretive center.

EPILOGUE

Commission Ruling

The findings of the PSCW commissioners were written in a document entitled FINDINGS OF FACT AND ORDER (PSCW, 1978), an excerpt from that document contains the following statements:

> The commission finds that because of the special unique geological features of the Cross Plains Unit, its special significance at national, state and local levels to the public in the appreciation and understanding of the Ice Age, and the expected extensive use of the Cross Plains Unit by the public in furthering its knowledge of the Ice Age in Wisconsin, the Cross Plains Unit is particularly important from a public interest standpoint. The commission fully understands the relatively high cost of underground versus overhead construction and that

> underground construction will have some relatively small impact on rates paid by customers of Wisconsin Power and Light Company. Nevertheless, the commission considers that in this particular case the public interest supports a requirement for underground construction in the vicinity of the Cross Plains Reserve Unit.
>
> The commission will accordingly herein require that Wisconsin Power and Light Company utilize underground instead of overhead construction... .
>
> This determination is not considered to be precedent setting in terms of future transmission line projects, but rather one which reflects the uniqueness and importance of the Cross Plains Unit and the stated, significant public interest considerations involved.

As to the precedential issues, one commissioner dissented.

> My decision is based on a test of balancing these interests (economic vs. environment) in a manner consistent with the overall general public interest which I feel requires undergrounding, considering the uniqueness of the Reserve. There is precedential value in this decision. (PSCW 1978, p. 16.)

One PSCW commissioner reflected his overall attitude in the following poem (PSCW 1978, p. 14):

> Would the valleys were your
> streets, and the green paths your
> alleys, that you might seek one another through vineyards, and come
> with the fragrance of the earth in
> your garments.
>
> The Prophet, Kahlil Gibran

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Wildlands Management for Wildlife Viewing[1]

Tamsie Cooper and William W. Shaw[2]

Abstract: Wildlife in general and wildlife viewing in particular play significant roles in enriching the aesthetic experiences of visitors to wildlands. Effective management of wildlife for viewing must be based on human as well as biological information. The integration of the principles and techniques developed for game management with information on the human dimensions of wildlife appreciation offers tremendous potential in management of wildlife as a visual resource. These opportunities can not only provide benefits to the public but can also serve to stimulate awareness and concern for our national landscape.

INTRODUCTION

Landscape aesthetics are a function of many different environmental components. Topography, vegetation, scenic vistas and human developments are most often considered by planners concerned with the aesthetic values of an area. Too often overlooked are the potentials for planning and managing areas to provide opportunities for viewing wildlife. Wildlife are valuable aesthetic resources in any natural or semi-natural environment and the potential for land use planning and management to provide wildlife viewing opportunities is great. This paper discusses some of these opportunities and some guidelines for incorporating wildlife aesthetics into planning and management processes.

Appreciation of wildlife as a visual resource appears to be increasing in our society. A recent survey estimated that over 49 million Americans participated in some form of wildlife observation in 1975 (USDI) and memberships in animal-oriented organizations of all types have burgeoned (Witter 1977). In many natural and semi-natural areas, wildlife is an important and essential resource complementing other scenic natural amenities that attract outdoor recreationalists. Current research at the University of Arizona is revealing some areas in which opportunities for viewing wildlife are the primary attraction for thousands of recreational visitors (Witter *et al*. 1978, Shaw *et al*. 1978, Richards *et al*. 1979).

These studies are part of the growing body of evidence indicating that for many Americans, aesthetic values of wildlife are very significant. Other important studies dealing with aesthetic values of wildlife include Hendee (1969), Dagg (1974), Horvath (1974), Payne and DeGraff (1975), Langenau (1975), Kellert (1978), and More (1979). A review of current research on this topic consistently shows that appreciative enjoyment of wildlife appears to be increasing and by some measures is even outdistancing the more traditional commodity values for wildlife. In spite of this evidence, the potential of managing wildlife for aesthetic purposes has been sorely neglected.

Traditionally, the group most interested in wildlife management, as well as the group providing most of the revenue for management activities, has been the sport-hunter. Quite naturally, this has resulted in the development of scientific techniques aimed primarily at management to produce a harvestable surplus of game species. However, it is important to point out that management for hunting is not necessarily incompatible with management for aesthetic uses--in fact, in many ways non-hunted species have benefited from habitat preservation and other activities associated with traditional game management. Fortunately, much of the knowledge and techniques developed for game management can be transferred to considerations of wildlife as a visual resource.

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The aesthetic and existence values of wildlife are becoming well recognized by resource management agencies. However, due to financial constraints, nongame management is still relatively minimal. As of 1975, only seventeen states had nongame programs that even included one full-time employee (Wright 1976). The problem facing all nongame programs is one of large numbers of wildlife species and aesthetic values to be considered, with inadequate staffing and revenue supplied to meet the management needs.

A significant exception has been in the area of management of endangered species. The endangered species Acts of 1966, 1969, and 1973 have provided the impetus for major efforts in management of some species. These laws, along with other state and federal legislation or proposed legislation involving wild horses, burros, trapping regulations, and other wildlife issues,are reflections of society's interest in wild animals. Understandably, though, most of these laws deal with protection of these species, rather than provision for viewing opportunities.

But many species are not endangered, and can provide aesthetic experiences without threatening the well-being of the animals involved. More attention to the potential of managing wildlands for wildlife viewing opportunities is long overdue. Wildlife management and resource management in general must be evaluated in terms of human benefits. Public interest in wildlife as a visual resource appears to be substantial and increasing, and one way wildland managers might increase human benefits is deliberately to provide opportunities for wildlife appreciation in wildland settings.

WILDLIFE VIEWING OPPORTUNITIES AS ONE PRODUCT OF WILDLAND MANAGEMENT

Effective management of wildlands for wildlife viewing will require input from several areas of expertise including wildlife biologists, resource planners and managers, and social scientists. Figure 1 illustrates a process for incorporating this objective into management and planning activities.

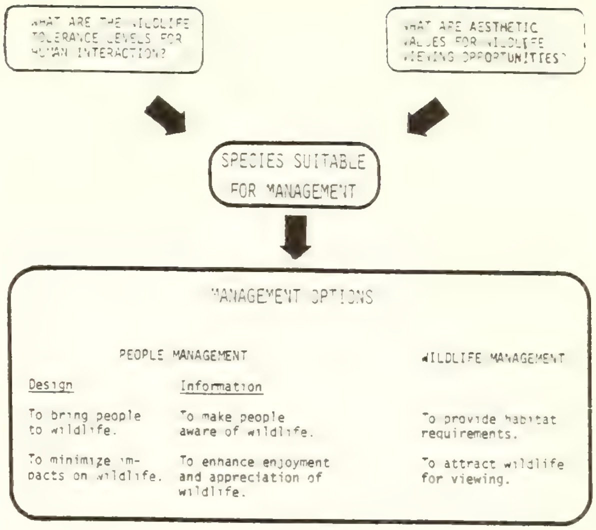
WHAT ARE THE WILDLIFE TOLERANCE LEVELS FOR HUMAN INTERACTION?
WHAT ARE AESTHETIC VALUES FOR WILDLIFE VIEWING OPPORTUNITIES?
SPECIES SUITABLE FOR MANAGEMENT
MANAGEMENT OPTIONS
PEOPLE MANAGEMENT
WILDLIFE MANAGEMENT
Design
Information
To bring people to wildlife.
To minimize impacts on wildlife.
To make people aware of wildlife.
To enhance enjoyment and appreciation of wildlife.
To provide habitat requirements.
To attract wildlife for viewing.

Figure 1--Management Guidelines for Wildlife Viewing Opportunities

Wildlife Tolerance of Human Interaction

Wildlife vary in their tolerance of human interactions. Some are very sensitive to any human activities and others can tolerate or even benefit from association with humans. Just as certain species can provide harvestable surpluses, and hence opportunities for hunting recreation, some species can provide viewing opportunities without serious effects on the population or ecosystem. One of the first questions in identifying possibilities for providing wildlife viewing opportunities is to determine the degree of vulnerability of the various species in the area.

There are numerous examples of game as well as non-game species which tolerate nonthreatening human activities with minimal disruption. For example, during winter and migration periods, wild waterfowl often concentrate in highly urbanized areas such as Lake Merritt in downtown Oakland, California. These ducks provide considerable viewing opportunities during part of the year and revert to wilder behavior during the breeding season. Likewise, deer, elk and other hunted ungulates can become fairly tame in protected situations without losing their wildness or ability to survive without humans (Behrend and Lubeck 1968). The presence of various birds, small mammals and reptiles can enhance almost any outdoor recreational experience. In many cases these opportunities for enjoying wild animals exist through no effort on the part of the management agency. One thesis of this paper is that many more positive interactions with wildlife are possible with relatively minor efforts on the part of planners and managers.

Of course, some species simply are not suited for human observation due to their behavioral or ecological requirements. For example, the low population density and secretive behavior of mountain lions and bobcats make observation unfeasible for most recreationalists. Other species are very intolerant of human activities for part of or all of the year. One would certainly not promote viewing of species where human proximity might lead to unsuccessful reproduction or abandonment of critical habitat as may be the case for certain birds as well as large ungulates such as bighorn sheep. In some cases such intolerance might be only a seasonal phenomenon; in other cases human proximity may be detrimental at any time.

The important thing to recognize is that animal tolerance of humans runs the entire continuum from highly tolerant to highly intolerant. In between these two extremes are many species that may be capable of providing aesthetic experiences under certain conditions which can be controlled by the land management agency. Viewing opportunities under carefully controlled conditions may even be appropriate for endangered species where an adequate buffer is provided between people and the animals. Every year thousands of people view southern sea otters from the coastal cliffs of California and whooping cranes from specially designed blinds and observation towers in southern Texas. In fact, the endangered status of these species undoubtedly increases their value as visual resources.

In every initial planning effort, we must remember that each species has a unique tolerance to human interactions; understanding of these tolerances is perhaps the most critical factor in providing appropriate viewing opportunities. Wildland managers will be well advised to seek the expertise of wildlife biologists in answering these questions.

Aesthetic Values

A second important question is the value of various species in providing viewing enjoyment. Certain species are more popular than others as viewing subjects. In general, the aesthetic appeal of wild animals is a function of a variety of factors including size, age, color, life history, habitat and scarcity. Large mammals such as deer, bear and elk may be more popular than smaller mammals (Bart 1978). A bear and her cubs, a new fawn, or a nest of robins can offer particular enjoyment to a viewing experience. Colorful birds such as cardinals and jays are often liked more than thrashers or towhees (Brown and Dawson 1978). Predatory animals such as hawks, eagles and mountain lions seem to have a unique appeal. The setting of the viewing experience is important also. Viewing a bear or deer in a cage or even a natural appearing enclosure is much different from a viewing experience in a wild environment (More 1978). Finally, humans attach special values to opportunities for viewing rare animals. A non-endangered minnow probably has little aesthetic value but an essentially similar desert pupfish may become attractive because of its endangered status.

Provision of high quality wildlife viewing will require more than biological input. It is essential to understand the human experiences provided by the viewing opportunities, a job which can best be done by enlisting the aid of social scientists who recognize that aesthetic values involve physical stimuli plus cognitive processes whereby significance is attached to an object. In the case of wildlife, this cognitive component may be particularly important (Shaw 1979).

Combining the biological assessment of each species' tolerance to humans with the sociological appraisal of desirability for viewing opportunities can lead to identification of those species most appropriate for providing viewing opportunities. A major thesis of this paper is that wildlife viewing opportunities demand attention from, and cooperation among, several fields. With the knowledge of which are suitable species, the next question emerges: How can this knowledge be translated into a successful viewing experience?

People Management

Design

Design can be a useful vehicle for bringing people and wildlife together. People concentrate themselves along roads, trails, campgrounds and other environments made accessible by design (Gill and DeGraaf 1974). Thus, design and placement of facilities in wildlands are major factors in providing most wildlife viewing opportunities.

In some cases, design considerations for wildlife viewing can be relatively simple and inexpensive. Providing roadside pullouts in areas where people are likely to view wildlife can provide an otherwise unavailable opportunity. A design decision to place picnic tables near desert washes or rocky outcroppings instead of in open areas is a simple matter, but can greatly increase viewing of birds, rodents and small mammals. In other cases, design can be used to take people into areas that are otherwise inaccessible. For example, boardwalks in swamps increase opportunities for viewing birds, fish and alligators. Even colonial nesting populations of birds such as egrets can be enjoyed when the design of trails and blinds places people in locations that do not disturb the birds.

More elaborate uses of design can bring people in very close proximity to animals in their natural habitat. One example of this is the building of a visitor center in such a way as to provide underwater viewing of a stream and its inhabitants. Similar facilities could undoubtedly be developed to bring people close to terrestrial wildlife using the expertise of wildlife biologists and design and planning specialists.

Information

Perhaps the most powerful strategy available to management and often the least costly is provision of information to the viewing public. Information is powerful not only in the sense that it can significantly increase viewing opportunities for persons, but that, in addition, it can increase general awareness and aesthetic appreciation of wildlife and its ecology (Sharpe 1976). From environmental and interpretative education to simple signs and displays along trails, dissemination of information can take many forms and each of these can be a valuable tool in increasing human enjoyment of wildlife.

Laws, customs and regulations have traditionally been used to inform the public of their responsibilities toward wildlife. In wildlands such information often takes the form of use limits, prescribed use of certain areas, time restrictions and law enforcement. Yet, dissemination of information for protection purposes can have effects beyond the protection specifically intended. For instance, a large sign warns when a "Trogon Management Area" in the Chiricahua Mountains of southeast Arizona is being entered. The purpose of the sign is to inform people of the restricted nature of the area. As a result, however, many visitors who otherwise would have known nothing of the birds have become aware of their presence and are now viewing them. Such effects can be good or bad, depending on the circumstances, but the point is that resource managers must be aware of the real and powerful effects that communication of information can have on an area and the wildlife that livesthere.

Often the most profitable kind of information that can be given to the public is on the predictable behavior and life history of animals. Such things as breeding and courtship activities, feeding habits, preferred food items and seasonal movements are but a few animal characteristics which when known can contribute greatly to viewing enjoyment. This kind of information disseminated in an interesting and responsible manner may not only help in locating wildlife for viewing, but it may also alert the viewers to particularly exciting times for observation in an animal's life. Numerous examples of using information to enhance enjoyment of wildlife exist at interpretative facilities of various resource management agencies but much more could be done.

Wildlife Management

One of the most important tenets of wildlife management is that wildlife are a part of and largely controlled by their resource base. A species' success, or extinction, depends on the quality and availability of resources such as food, water, and cover (Leopold 1933). Thus a large part of wildlife management is habitat management. Depending on the goals involved, this management can provide ways of attracting wildlife and human impacts, or ways of providing escape or cover for wildlife. Since habitat management is a key factor in the survival and presence of a given species in an area, it is also critical to the provision of viewing opportunities.

Attracting wildlife to certain areas for viewing is certainly not a new idea. Tens of thousands of backyards are set up as feeding stations for precisely that purpose. However, few formal wildland management plans have used their resources to increase viewing opportunities. On the contrary, most management has involved manipulation in order to provide cover, or a buffer to cushion human impact (Schoenfeld and Hendee 1978). However, where habitat management has been used to enhance viewing, it has met with success. For example, bird sightings in some Appalachian forests have been increased through management efforts (Gill and DeGraaf 1974). Where vegetation was lacking along trails and in campgrounds, additional nesting vegetation has been planted and nesting boxes have been provided.

Controlled burning to diversify vegetation and generate new successional forest growth provides many of the requirements needed by wildlife and can significantly increase their presence and diversity in such areas. In western states, grazing patterns on range lands and in riparian areas can be manipulated to benefit wildlife and the provision of water in desert areas has a tremendous potential for attracting wildlife. If wildlife viewing is adopted as a land management objective the techniques of habitat manipulation most often used in providing sport hunting opportunities would have innumerable applications.

CONCLUSION

Wildlife is important to Americans for many reasons, but during the past few years we have experienced a tremendous growth in the appreciation of the aesthetic values of wild animals. Along with this growth must come recognition by land use planners and managers that wildlife can be managed effectively as visual resources. The purpose of this presentation has been to set forth some of the important considerations which must be made in managing wildlife as a visual resource. Determining the tolerance levels of wildlife species and assessing human values for wildlife are critically important considerations. Important, too, are decisions as to which species are suitable for viewing and which are the most appropriate management strategies to provide viewing opportunities. These decisions demand cooperation among several professions: wildlife biology, social sciences, design, and resource management. Such an interdisciplinary effort is often difficult to initiate but its benefits in terms of providing aesthetic experiences for people can be great.

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Potential Future Impacts on Visual Air Quality for Class I Areas[1]

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Abstract: Visual air quality is most sensitive to degradation by air pollution in areas with good visibility. The protection of visual air quality in mandatory Class I Federal areas has been declared a national goal by Congress. Impacts on visual air quality are calculated for 154 Class I areas where visual air quality is considered an important value. These impacts are potential future impacts in 1985 and 1990 due to DOE's "Mid-Mid" Energy Scenario.

INTRODUCTION

Visual air quality is degraded by air pollution. It is very sensitive to degradation in pristine areas with very good visual air quality. The degradation of visual air quality is of particular concern in the Rocky Mountain region where there is both an abundance of pristine areas and coal resources. The combustion of coal can cause significant air pollution. Congress has recognized visual air quality as an important value. For mandatory Class I Federal areas where impairment in visual air quality results from manmade air pollution, Congress has declared as a national goal the prevention of future impairment and the remedying of existing impairment (Public Law 95-95 subpart 2, Section 169A).

In fiscal year 1979, DOE initiated an intensive study on the socioeconomic and environmental impacts of the Mid-Mid Energy Scenario. This study--the Regional Issue Identification and Assessment (RIIA) program --involves all the national energy laboratories. Each national laboratory directed one or more aspects of the study. In addition, each laboratory assessed all of the scenario's impacts on its geographical region. Los Alamos Scientific Laboratory (LASL) assumed the lead lab role in visual air quality assessment and was responsible for evaluating energy development impacts in the Rocky Mountain region. This paper describes the methodology employed by LASL to calculate visual air quality in Class I areas in the U.S. in 1985 and 1990, and presents the results of the RIIA study pertaining to atmospheric visual air quality.

The scenario, known as the Projection Series C or the TRENDLONG Mid-Mid Scenario, is one of six possible energy futures produced by the Energy Information Administration of the Department of Energy (DOE) for the Department's 1977 Annual Report to Congress. For this scenario, it is assumed that there is medium energy demand and fuel supply through 1990. The national energy supply and demand balance for this scenario is summarized in Table 1. County level sitingsof utility and industrial fossil-fueled power plants were projected for 1985 and 1990 for this scenario. The sitings were done by Oak Ridge and Brookhaven National Laboratories.

For the assessment of this scenario, it was assumed that sulfur dioxide and primary particulate emissions from fossil-fueled combustion facilities were effectively controlled. Utility energy facilities with start-up dates before 1984 and industrial energy facilities were assumed to meet the more stringent of either the New Source Performance Standards (NSPS) or the State Implementation Plan (SIP) requirements.

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TABLE 1--1990 ENERGY SUPPLY/DEMAND BALANCE, MID-MID SCENARIO (QUADRILLION BTU PER YEAR)

	1975	1985	1990
DOMESTIC PRODUCTION			
Crude Oil	17.9	19.0	18.0
NGL & Butane	2.6	2.0	1.8
Shale Oil	0	.1	.3
Natural Gas	19.0	17.2	16.7
Coal	14.6	23.1	27.5
Nuclear	1.8	6.2	10.3
Hydro & Geothermal	3.2	4.2	5.0
TOTAL DOMESTIC PRODUCTION	59.1	71.8	79.6
IMPORTS			
Crude Oil	8.7	16.5	20.9
Petroleum Products	3.8	6.7	7.8
Natural Gas	1.0	1.9	2.6
TOTAL IMPORTS	13.5	25.1	31.3
TOTAL SUPPLY	72.6	96.9	110.0
DOMESTIC CONSUMPTION			
Oil	32.8	43.9	48.5
Natural Gas	20.0	19.1	19.3
Coal	12.8	21.2	25.4
Nuclear	1.8	6.2	10.3
Hydro & Geothermal	3.2	4.2	5.0
TOTAL DOMESTIC	70.6	94.6	108.5
EXPORTS			
Coal	1.8	1.9	2.1
Refinery Loss	.2	.4	.3
TOTAL CONSUMPTION & EXPORT	76.6	96.9	110.9
DOMESTIC CONSUMPTION BY SECTOR			
Residential	14.7	19.0	21.2
Commercial	11.3	13.5	15.0
Industrial	26.0	40.7	49.0
Transportation	18.6	21.4	23.3
TOTAL DOMESTIC CONSUMPTION	70.8	94.6	108.5

Utility energy facilities with start-up dates in 1984 and beyond were assumed to be subject to Best Available Control Technology (BACT) requiring 85 per cent removal of sulfur dioxide (SO_2) for locally available coal (90 per cent as a long term average), but subject to an emissions floor of .2 lbs. $SO_2/10^6$ Btu. The air pollution emission analysis by county was done by Brookhaven National Laboratory. The impact on visual air quality in 1985 and 1990 due to emission sources other than utility and industrial fossil-fueled power plants was held at the levels which were estimated to exist during the baseline years.

METHODOLOGY

Through a relationship proposed by Koschmieder (Middleton 1952), visual range for black objects can be related to the extinction coefficient, b, defined in the Beer-Lambert law. The relationship has also been found to be a good approximation for calculating the visual range of dark topographical features such as forest covered mountains. The relationship for the limiting distinguishable contrast of a black object against the horizon sky for a standard observer is given by the following simple relationship:

$$V = \frac{3.912}{b} \qquad (1)$$

V is known as the "meteorological range." The value used for the limiting distinguishable contrast for the standard observer is .02 (Middleton 1952).

The extinction coefficient can be represented by the sum of the following components (Charlson 1969): the light scattering coefficient due to atmospheric particles, b_{sp}, the light scattering coefficient due to air molecules (Raleigh Scattering) b_{sg}, the light absorption coefficient due to gases such as NO_2, b_{ag}, and the light absorption due to particles such as carbon black, b_{ap}. The relationship can be represented as follows:

$$b = b_{sp} + b_{sg} + b_{ag} + b_{ap} \qquad (2)$$

For nonurban areas, where the Class I areas of interest are located, the anthropogenically related extinction is primarily due to light scattering by particles. The concentration of NO_2 tends to be too low for light absorption by gases to be important and the light absorption coefficient due to particles tends to be an order of magnitude less than the light scattering coefficient due to particles.

The light scattering coefficient for a particulate species can be calculated as a product of its scattering to mass ratio, b_s/m, and its mass concentration, m. Particles in the size range comparable to the wavelength of light, .1 to 1 microns in radius, are the most effective light scatterers per unit mass (White and Roberts 1977). Particles in the accumulation mode, formed by the chemical reaction and condensation of gases, are found in this size range (Friedlander 1977). The bulk of the particulates in the accumulation mode are composed of sulfate, nitrate, and organics with particulate sulfate typically comprising the largest mass fraction. Submicron particles, in the nuclei mode, and particles greater than 1 micron, in the coarse particle mode, are not effective light scatterers per unit mass.

For hygroscopic particles, the particles will grow in size with increasing relative humidity. The particle growth will cause the scattering to mass ratio to increase which can be mathematically expressed as follows (Cass 1976):

$$(b_s/m)_{RH} = (b_s/m)_o*(1 - (RH/100))^n \quad (3)$$

$(b_s/m)_{RH}$ = the scattering to mass ratio at relative humidity, RH.

$(b_s/m)_o$ = the scattering to mass ratio at zero relative humidity.

Cass has estimated values of n for Los Angeles which range from -.53 to -1.09 for particulate sulfates and nitrates. Trijonis and Yuan (1977 and 1978) used a value n for of -1 in their regression analyses. An inspection of plots of the scattering coefficient versus relative humidity based upon measurements in Seattle, Washington, Denver, Colorado, and Altadena, California, indicates that a value of n = -1/2 fits the data better than a value of n = -1 (Covert, Charlson, and Ahlquist 1972).

The extinction coefficient calculated from visual range observations has been significantly correlated with the concentrations of particulate sulfates ($SO_4^=$), particulate nitrates (NO_3^-), total suspended particulates (TSP), excluding the former two components, and relative humidity. Regression relationships with these pollutants as independent variables have been fitted to extinction coefficient data. (Trijonis and Yuan 1977 and 1978, White and Roberts 1977, Cass 1976). The regression coefficients can be interpreted as the extinction coefficient per unit mass for each pollutant.

The extinction coefficient and visual range are used as the indices of visual air quality. The use of the extinction coefficient to characterize visual air quality has been recommended by Charlson, Waggoner, and Thielke (1978). The limitations of the extinction coefficient for characterizing visual air quality are the following: It does not account for coloration effects. The visual perception of a scene is affected by the position of the observer and the sun. It does not completely characterize the visual range of colored objects. It is assumed that atmospheric concentrations of light scattering aerosols are spatially homogeneous. It does not characterize the case of plume blight. Plume blight needs to be examined on a case by case basis. The major advantages of the extinction coefficient are that it is simple to calculate and interpret, the scattering portion can be directly measured, its components are additive, and its relationship to visual range has been successfully tested.

The total light extinction for Class I areas is calculated as the sum of the following three components: (1) light scattering due to gas molecules, b_{sg}, Raleigh scattering, (2) extinction due to the sources and light scattering aerosols accounted for in long-range transport calculations, and (3) the remaining light extinction due to the sources and light scattering aerosols not accounted for in long-range transport calculations. The equation used for the calculation of the total light extinction coefficient, b_T, is expressed as follows:

$$b_T = b_{sg} + \sum_i \sum_j b_{sij} + b_r \quad (4)$$

b_{sg} = light scattering due to air molecules. $b_{sg} = .15 \times 10^{-4}$ meters^{-1} at sea level.

b_{sij} = light scattering due to aerosol i and source j.

b_r = the remaining light extinction due to the sources and light scattering aerosols which were not accounted for in the long range transport calculations.

The light scattering coefficient, b_{sij}, is calculated using Equation (3). The estimation of the scattering to mass parameters is discussed in the next section. The mass concentrations are from long-range transport predictions which were supplied by Pacific Northwest Laboratory for the western United States and Brookhaven National Laboratory for the entire United States. Pacific Northwest Laboratory predicted the concentrations of particulate sulfates due to sulfur dioxide emissions from major industrial process sources and from utility and industrial fossil-fueled power plants and predicted the concentrations of primary particulates (PP) due to emissions from utility and industrial fossil-fueled power plants. Brookhaven National Laboratory predicted the concentrations of particulate sulfates due to sulfur dioxide emissions from utility and industrial fossil-fueled power plants.

The major share of the calculated light extinction is accounted for by b_{sij}. The major anthropogenic sulfur dioxide emission source categories were accounted for in the long range transport calculations (Table 2). Extinction budget calculations summarized in Table 3 indicate that the major share of the light extinction in nonurban areas is due to particulate sulfates which are formed by the oxidation in the atmosphere of sulfur dioxide. These results are supported by the extinction budgets for the southwest and northeast prepared by Trijonis and Yuan (1977 and 1978). The greatest uncertainty in the calculation of the total light extinction coefficient is the contribution of natural sources. Except for meteorologically related impairment of visual

TABLE 2--REGIONAL SULFUR DIOXIDE EMISSIONS BY POLLUTANT AND SOURCE CATEGORY[1]

Lab Region	States In Lab Region	Source Category	Sulfur Dioxide Emissions (tons/yr)	Percent of Total Emissions
ANL	IL, IN, IA, KS, MI, MN, MO, NE, ND, OH, SD, WI	Utility	6,627,454	53.1
		Indus.	2,726,342	21.8
		Indus. Process	754,627	6.0
		Total	12,479,843	
BNL	CT, DE, ME, MD, MA, NH, NJ, NY, PA, RI, VT	Utility	4,076,303	57.6
		Indus.	1,372,133	19.4
		Indus. Process	464,996	6.6
		Total	7,077,186	
LBL	CA, NV	Utility	113,776	14.8
		Indus.	61,011	7.9
		Indus. Process	434,390	56.4
		Total	769,609	
LASL	AZ, CO, MT, NM, UT, WY	Utility	193,903	5.4
		Indus.	42,091	1.2
		Indus. Process	3,280,944	91.1
		Total	3,600,612	
ORNL	AL, AR, FL, GA, KY, LA, MS, NC, OK, SC, TN, TX, VA, WV	Utility	5,393,078	68.8
		Indus.	668,959	8.5
		Indus. Process	885,003	11.3
		Total	7,842,900	
PNL	ID, OR, WA	Utility	421	.1
		Indus.	44,107	11.1
		Indus. Process	294,051	73.2
		Total	401,411	

[1] Source: (U.S.E.P.A. 1974)

[2] ANL = Argonne National Laboratory
BNL = Brookhaven National Laboratory
LBL = Lawrence Berkeley Laboratory
LASL = Los Alamos Scientific Laboratory
ORNL = Oak Ridge National Laboratory
PNL = Pacific Northwest Laboratory

[3] Industrial refers to industrial fossil fuel combustion facilities.

air quality, visual air quality as indicated by airport observations of visual range is strongly related to regional anthropogenic air pollutant emissions. (Trijonis and Yuan 1977 and 1978 and Trijonis and Shapland 1978).

The light extinction budget presented in Table 3 is a summary by National Energy Laboratory Region of the estimated per cent of the extra extinction due to particulates sulfates, particulate nitrates, and total suspended particulates (TSP), excluding sulfates and nitrates. The light extinction is calculated from relative humidity and nonurban air quality data for the period of 1970 to 1974. The scattering to mass ratio estimates discussed in the next section were used in the calculations. Extra extinction accounts for all extinction except for the extinction due to Raleigh scattering.

The remaining light extinction is assumed to remain at existing, baseline levels. It is calculated from the baseline extinction and factors which account for excluded emission sources and light scattering aerosols. The baseline extinction is calculated from median visual range statistics (Trijonis and Shapland 1978), using the Koschmieder relationship. The remaining extinction is calculated as follows:

$$b_r = (b_b - b_{sg})*(\sum_i F_{1ik} * F_{2il}) \qquad (5)$$

b_b = baseline extinction.

F_{1ik} = the fraction of the total emissions of pollutant i in region k for sources not accounted for in the long range transport analyses. It is calculated from data in the 1972 National Emissions Report (U.S.E.P.A. 1974).

F_{2il} = the fraction of the total light extinction due to aerosol i in region 1.

PARAMETER ESTIMATION

The scattering to mass ratios typical of nonurban locations and at zero relative humidity as defined by Equation 3 were estimated using linear regression analysis. This approach has been used in previous studies (Trijonis and Yuan 1977 and 1978, White and Roberts 1977, Cass 1976). The scattering to mass ratios for fine particulate matter (FPM) and for Total Suspended Particulates (TSP) excluding FPM were estimated. The former accounts for light scattering due to particles in the accumulation mode and the latter accounts for light scattering due to particles in the coarse particle mode. The sum of particulate sulfate and nitrate concentrations was used to represent the concentration in the FPM mode. The sulfate and nitrate concentrations were multiplied by 1.3 to account for the mass of associated cations which are thought to be primarily the ammonium ion.

Averages of annual average nonurban air quality data for the period of 1970 to 1974 were used in the regression analysis . These were data from measurements taken at 39 nonurban National Air Surveillance

TABLE 3--EXTINCTION BUDGETS BY LAB REGION, SUMMARY STATISTICS[1]

Lab Region	Sample Size	PERCENT EXTRA EXTINCTION					
		Sulfates ($SO_4^=$)		Nitrates (NO_3^-)		($TSP - SO_4^= - NO_3^-$)	
		Mean	Range	Mean	Range	Mean	Range
ANL	6	75.2	70.2-88.6	10.3	.266-16.4	14.6	11.2-18.3
BNL	9	77.1	69.9-83.4	9.46	5.52-13.2	13.4	9.86-17.0
LBL	2	74.0	69.9-78.2	11.2	10.4-12.1	14.7	11.3-18.1
LASL	7	75.1	52.7-90.3	10.5	.208-35.3	14.4	9.38-22.0
ORNL	12	68.8	57.2-79.0	13.6	6.62-20.6	18.6	9.58-28.0
PNL	3	74.0	66.5-81.4	10.3	5.54-17.5	15.6	10.7-20.4

[1] They are the summary statistics grouped by lab region of the extinction budgets calculated for nonurban ambient air quality monitoring sites.

[2] TSP = Total Suspended Particulates.

Network air quality monitoring sites (Table 4). Seventeen sites were located in western states and twenty-two were located in eastern states. Mean daily relative humidities, (annual), which were typical of the area in the vicinity of the sites were used (Baldwin 1973). The observed values for the light extinction coefficient were calculated from the observed visual range data using the Koschmieder relationship. The observed visual range data were taken from isopleth maps compiled by (Trijonis and Shapland 1978). They are median values for the period of 1974 to 1976.

The scattering to mass ratios were estimated for three values of the relative humidity exponent, -1/2, -2/3, and -1 (table 5). The regression equation for which the exponent was -1/2 gave the best fit to the data. As would be expected, the scattering to mass ratio for FPM was estimated to be much higher than for TSP minus FPM in both the western and the eastern states. The higher scattering to mass ratio for TSP minus FPM in the east as compared to the west could be explained by the coarser particles in the west being larger in size due to a greater contribution from wind blown dust and a smaller contribution from industrial sources. The standard deviation of the parameter estimates was relatively smaller for FPM as compared to TSP minus FPM. The variance explained in the regression for the exponent of -1/2 was 66.7 per cent.

RESULTS

Currently, there are no quantitative criteria of acceptable visual air quality for Class I areas. By August 1979, EPA must promulgate regulations which will (1) provide guidelines to states for including visibility in State Implementation Plans (SIP) where needed, and (2) require SIP's for affected states to include emission limits, schedules for compliance, and other measures as may be necessary to make reasonable progress toward

TABLE 4--NONURBAN AMBIENT AIR QUALITY MONITORING SITE LOCATIONS

State	Location
Arizona	Grand Canyon National Park Maricopa County
Arkansas	Montgomery County
California	Humboldt County
Colorado	Mesa Verde County
Delaware	Kent County
Florida	Hardee County
Idaho	Butte County
Indiana	Monroe County Parke County
Louisiana	Iberville Parish
Maine	Acadia National Park
Maryland	Calvert County
Mississippi	Jackson County
Missouri	Shannon County
Montana	Glacier National Park
Nebraska	Thomas County
Nevada	White Pine County
New Hampshire	Coos County
New Mexico	Rio Arriba County
New York	Jefferson County
North Carolina	Cape Hatteras
Oklahoma	Cherokee County
Oregon	Curry County
Pennsylvania	Clarion County Indiana County
Rhode Island	Washington County
South Carolina	Richland County
South Dakota	Black Hills National Park
Tennessee	Cumberland County
Texas	Matagorda County Tom Green County
Vermont	Orange County
Virginia	Shenandosh National Park Wythe County
Washington	King County
Wisconsin	Door County
Wyoming	Grand Teton National Park Yellowstone National Park

TABLE 5--SCATTERING TO MASS RATIO PARAMETER ESTIMATES[1]

Relative Humidity Exponent	Sum of the Squares of the Errors	Fine Particulate Matter		Total Suspended Particulates -1.3 * (Sulfate + Nitrates)			
				West		East	
		Estimate	Standard Deviation	Estimate	Standard Deviation	Estimate	Standard Deviation
-.5	6.51	.0576	.0106	.00207	.00310	.00511	.00429
-.667	7.94	.0364	.0114	.00296	.00250	.00961	.00545
-1.00	9.68	.0246	.00782	.00199	.00173	.00526	.00371

[1] 10^4 meters$^{-1}/(\mu g/m^3)$

[2] $((10^{-4})$ meters$^{-1}/(\mu g/m^3))^2$

meeting national visibility goals (Coleman and Karash 1978). Congress recognized that it would be unreasonable to have a uniform visibility goal for all Class I areas. This means that the regulations promulgated by EPA can be different between regions of the country and between Class I areas within a region.

A first cut at defining criteria for rating visual air quality impacts due to both regional haze and plume blight conditions was made (Table 6). It is recognized that visual air quality is an aesthetic value which is subjective and has many dimensions. The criteria were selected based upon LASL's experience in producing computer simulated pictures of plume blight and regional haze under different conditions of meteorology, source characteristics, atmospheric chemistry, aerosol characteristics, background atmosphere, and plume geometry. Due to the inverse relationship between extinction and visual range, the per cent change in visual range is most sensitive to the marginal change in extinction in areas which experience the best visual air quality. The implications of this relationship are that areas with the best visual air quality are the most susceptible to degradation and the areas with the poorest will require a substantial decrease in air pollution before a significant improvement will occurr.

Impairment in visual air quality due to regional haze was projected to occur in fifteen Class I areas in the United States (Table 7). Class I areas in the Rocky Mountain states (Arizona, Colorado, Montana, New Mexico, Utah, and Wyoming) were screened for having potential for impairment in visual air quality due to plume blight. Seven Class I areas were identified as having potential for impairment due to plume blight (Table 8).

A summary by laboratory region of visual air quality calculations for 1990 is presented in Table 9. Visual air quality in Class I areas is the best in the western states, particularly in the Rocky Mountain states. It is the poorest in the eastern states, particularly in the southeast. In the

TABLE 6--DEFINITION OF CRITERIA FOR RATING VISUAL AIR QUALITY IMPACTS

High	Medium	Low
There is a greater than 20% decrease in calculated visual range in Class I areas. Power plants sited in counties with Class I areas are greater than 1000 MW in size for coal and oil-fired plants and greater than 2500 MW in size for gas-fired plants.	There is between a 10 and 20% decrease in visual range in Class I areas. Power plants sited in counties or adjacent to counties with Class I areas are between 500 and 1000 MW in size for coal and oil-fired plants and between 1250 and 2500 MW in size for gas-fired plants.	There is less than a 10% decrease in calculated visual range in Class I areas. Power plants sited in counties or adjacent to counties with Class I areas are less than 500 MW in size for coal and oil-fired plants and less than 1250 MW in size for gas-fired plants.

TABLE 7--CLASS I AREAS PROJECTED TO HAVE MEDIUM (M) AND HIGH (H) REGIONAL HAZE IMPAIRMENT

State	Class I Area	Impact
Colorado	Eagles Nest Wilderness	M
	Flat Tops Wilderness	M
	La Garita Wilderness	M
	Maroon Bells-Snowmass Wilderness	M
	Mesa Verde National Park	M
	Rocky Mountain National Park	M
	West Elk Wilderness	M
	Mount Zirkel Wilderness	H
	Rawah Wilderness	H
	Weminuche Wilderness	H
New Mexico	San Pedro Parks Wilderness	M
North Dakota	Lost Wood Wilderness	H
	Theodore Roosevelt National Monument	H
South Dakota	Badlands Wilderness	H
	Wind Cave National Park	H

eastern states, power plants are a major contributor to impairment of visual air quality in Class I areas whereas in the western states industrial process sources, smelters in particular, are a major contributor. In the western states, particulate sulfates due to fossil fuel combustion facilities are a much greater contributor to impairment of visual air quality in Class I areas than are primary particulates.

Computer generated maps displaying the visual range calculations in 1977 and 1990 for four southwestern states are shown in Figs. 1 and 2, respectively. The Class I areas displayed are defined in Fig. 3 and Table 10. This region has the best visual air quality in the nation (Trijonis and Shapland 1978). The poorest visual air quality is found in the southern part of the region, in the vicinity of 9 copper smelters located in Southern Arizona and New Mexico. The greatest deterioration in visual air quality is indicated to occur in Colorado. In this study, it is assumed that the sulfur dioxide emissions from the copper smelters will remain at their 1977 levels. The installation of improved sulfur dioxide control technology for the smelters would mean an improvement in visual air quality, particularly in the southern part of the region. The trend is toward improved sulfur dioxide control technology for the smelters. The major uncertainty concerns the pace at which the control technology will be installed.

TABLE 8--CLASS I AREAS IDENTIFIED TO HAVE POTENTIAL MEDIUM (M) and High (H) PLUME BLIGHT IMPAIRMENT

State	Class I Areas	Impact
Arizona	Grand Canyon National Park	M
Colorado	Flat Tops Wilderness	H
	Mount Zirkel Wilderness	H
	Mesa Verde National Park	H
New Mexico	San Pedro Parks Wilderness	H
Wyoming	Bridger Wilderness	M
	Fitzpatrick Wilderness	M

ERROR ANALYSIS

An estimation of the magnitude of the errors in calculating the light extinction coefficient, b, and the visual range, V, is attempted. One can compare calculated, X_c, and observed, X_o, values and take their differences. Their differences can be termed errors, e, or residuals.

$$e = (X_c - X_o)$$

The difference between a calculated and an observed value is due to different causes which include the following: (1) The observed value is not equal to the true value because of sampling and/or measurement error. (2) The long-range transport model (methodology), its parameters, and its input data, used for calculating aerosol concentrations (particulate sulfates and primary particulates) are an approximation to the true state of nature. Thus, the aerosol concentration

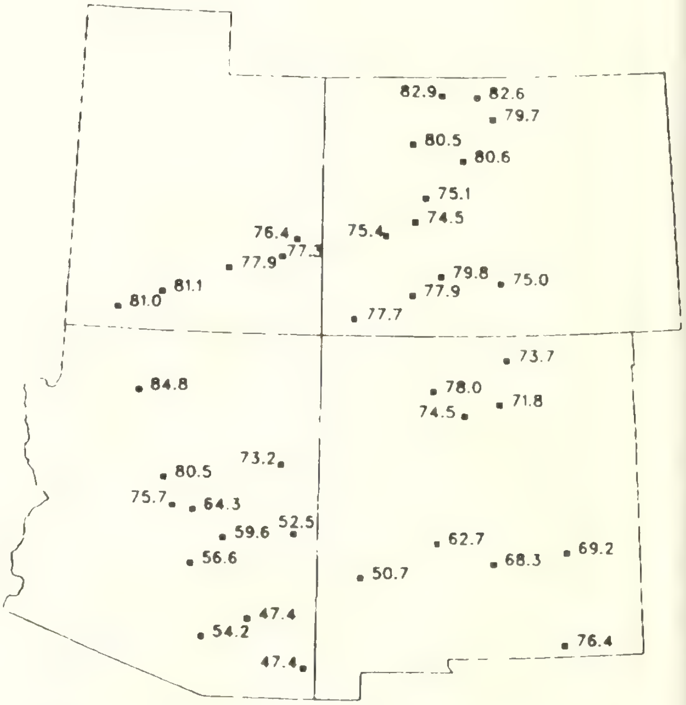

Fig. 1. Calculated visual range in Class I areas in the southwest - 1977.

TABLE 9--SUMMARY OF VISUAL AIR QUALITY CALCULATIONS FOR 1990

Lab Region	N	Per Cent Extra Extinction										Visual Range	
		Particulate Sulfates						Primary Particulates					
		Utility		Industrial		Industrial Process		Utility		Industrial			
		Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
ANL	10	28.1	0-54.2	.85	0-8.5	-	-	-	-	-	-	46.8	14.5-90.0
BNL	6	36.9	0-47.0	5.5	0-19.2	-	-	-	-	-		38.6	15.8-65.7
LBL	30	2.9	0-11.8	.4	0-5.9	5.2	0-22.2	0	0	.6	0-7.7	67.2	28.2-97.2
LASL	57	8.0	0-34.5	2.6	0-8.7	29.2	0-72.7	1.0	0-10.3	1.1	0-5.6	66.2	38.6-86.8
ORNL	26	37.3	0-64.8	5.0	0-13.0	-	-	-	-	-	-	19.1	10.7-60.8
PNL	25	1.3	0-6.4	4.8	0-13.7	4.9	0-29.2	0	0	3.3	0-9.8	46.4	28.9-75.9

[1] Number of class I areas in Lab Region.

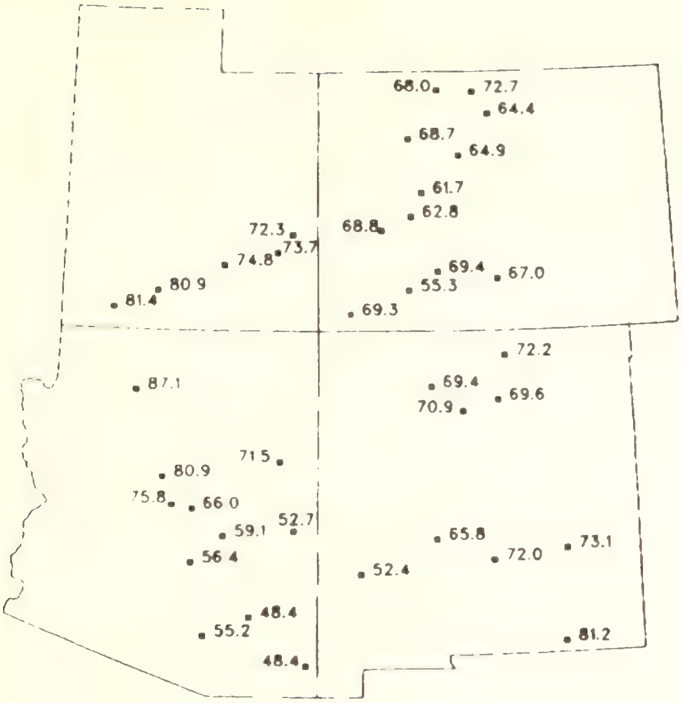

Fig. 2. Calculated visual range in Class I areas in the southwest - 1990.

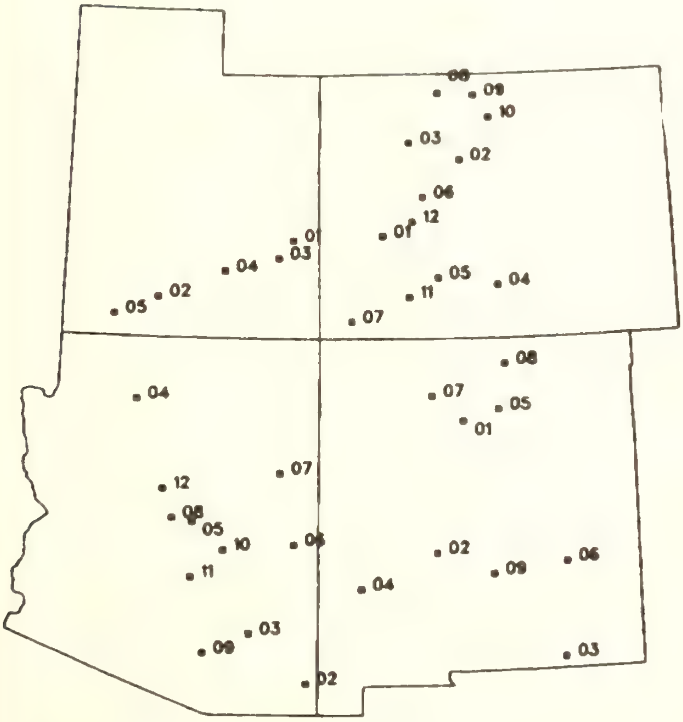

Fig. 3. Class I areas in the southwest.

TABLE 10--CLASS I AREAS IN ARIZONA, COLORADO, NEW MEXICO, AND UTAH

State	Number	Name
Arizona	1	Chiricahua National Monument Wilderness
	2	Chiricahua Wilderness
	3	Galiuro Wilderness
	4	Grand Canyon National Park
	5	Mazatzal Wilderness
	6	Mount Baldy Wilderness
	7	Petrified Forest National Park
	8	Pine Mountain Wilderness
	9	Saguaro Wilderness
	10	Sierra Ancha Wilderness
	11	Superstition Wilderness
	12	Sycamore Canyon Wilderness
Colorado	1	Black Canyon of the Gunnison Wilderness
	2	Eagles Nest Wilderness
	3	Flat Tops Wilderness
	4	Great Sand Dunes Wilderness
	5	La Garita Wilderness
	6	Maroon Bells-Snowmass Wilderness
	7	Mesa Verde National Park
	8	Mount Zirkel Wilderness
	9	Rawah Wilderness
	10	Rocky Mountain National Park
	11	Weminuche Wilderness
	12	West Elk Wilderness
New Mexico	1	Bandelier Wilderness
	2	Bosque del Apache Wilderness
	3	Carlsbad Caverns National Park
	4	Gila Wilderness
	5	Pecos Wilderness
	6	Salt Creek Wilderness
	7	San Pedro Parks Wilderness
	8	Wheeler Peak Wilderness
	9	White Mountain Wilderness
Utah	1	Arches National Park
	2	Bryce Canyon National Park
	3	Canyonlands National Park
	4	Capitol Reef National Park
	5	Zion National Park

predictions have errors associated with them. (3) The visibility model (methodology), its parameters, and its input data, used for calculating b and V are an approximation to the true state of nature. Thus, the calculations of b and V have errors associated with them.

Three error analyses concerning the calculation of b and V were conducted. The first was for the calculation of b and V in the vicinity of the 39 nonurban ambient air quality monitoring sites. The second was for the calculation of b and V for 154 Class I areas in the continental U.S. using Brookhaven's (BNL) long-range transport predictions, as one of the inputs. The third was for the calculation of b and V for 112 Class I areas in the west using Pacific Northwest Laboratory's (PNL) long-range transport predictions, as one of the inputs. In the case of the monitoring site calculations, the aerosol concentrations (particulate sulfates, particulate nitrates and total suspended particulate concentrations) were known. It should be pointed out that there is sampling and measurement error associated with the aerosol concentration data for the monitoring sites.

Two statistics are used to summarize the prediction errors for b and V. They are the average error, the bias,

$$\text{BIAS} = \frac{\sum_i e_i}{N}$$

and the square root of the mean square error also called the standard error of the estimate, SEE.

$$\text{SEE} = \frac{\sum_i e_i^2}{N}$$

Error analysis summaries for the monitoring site and the Class I area calculations of b and V are found in Tables 11 to 16. The summary statistics are by laboratory region.

TABLE 11--ERROR ANALYSIS, EXTINCTION COEFFICIENT CALCULATIONS FOR NONURBAN AMBIENT AIR QUALITY MONITORING SITES (10^{-4} METERS $^{-1}$)

Lab Region	Sample Size	Mean Obs.	Mean Calc.	BIAS	SEE
ANL	6	1.36	1.23	-.133	.441
BNL	9	1.45	1.69	.241	.407
LBL	2	.770	.692	-.078	.201
LASL	7	.425	.526	.101	.215
ORNL-I[2]	5	1.70	1.26	-.332	.534
ORNL-II[3]	7	2.04	1.78	-.254	.529
PNL	3	.868	.793	-.075	.221
All	39	1.30	1.25	-.044	.441

1. SEE = the standard error of the estimate.
2. AR, LA, OK, TX.
3. AL, FL, GA, KY, MS, NC, SC, TN, VA, WV.

TABLE 12--ERROR ANALYSIS, VISUAL RANGE CALCULATIONS FOR NONURBAN AMBIENT AIR QUALITY MONITORING SITES (Miles)

Lab Region	Sample Size	Mean Obs.	Mean Calc.	BIAS	SEE[1]
ANL	6	25.0	28.0	3.00	7.10
BNL	9	18.9	14.7	-4.22	6.77
LBL	2	47.5	40.9	-6.61	13.8
LASL	7	61.1	49.3	-11.7	19.8
ORNL-I[2]	5	19.0	21.0	1.95	4.64
ORNL-II[3]	7	12.1	15.1	2.92	4.25
PNL	3	30.0	36.2	6.20	14.6
All	39	28.5	26.8	-1.70	11.0

1. SEE = the standard error of the estimate.
2. AR, LA, OK, TX.
3. AL, FL, GA, KY, MS, NC, SC, TN, VA, WV.

For the monitoring site calculations, the standard error of the estimate of b and V by lab region tends to be positively correlated with the mean of b and V, respectively. The bias by lab region was less than one quarter and the standard error of the estimate by lab region tended to be from one-quarter to one-third of the observed mean for both b and V. The correlations between observed and calculated values for all regions and all cases were .817 for b and .856 for V.

For the Class I area calculations using BNL's long-range transport predictions, the errors mostly reflect errors in calculating the extinction caused by particulate sulfates due to utility and industrial boilers. This is because the extinction due to non-sulfate aerosols and due to nonutility and industrial boiler sources was apportioned from the observed extinction coefficient according to regional extinction budget and emission inventory factors. Thus, the errors are relatively small when the regional sulfur dioxide emissions from utility and industrial boilers are small in comparison to other sources. This is the case for LBL, LASL, ORNL-I, and

TABLE 13--ERROR ANALYSIS, EXTINCTION COEFFICIENT CALCULATIONS FOR CLASS I AREAS, BNL's LONG RANGE TRANSPORT PREDICTIONS(10^{-4} Meters $^{-1}$)

Lab Region	Sample Size	Mean Obs.	Mean Calc.	BIAS	SEE[1]
ANL	10	.971	.636	-.335	.379
BNL	6	.935	1.09	.153	.244
LBL	30	.829	.722	-.107	.132
LASL	57	.398	.388	-.011	.016
ORNL-I[2]	6	1.11	1.06	-.049	.076
ORNL-II[3]	20	1.82	1.78	-.045	.584
PNL	25	.724	.677	-.047	.049
All	154	.806	.750	-.056	.246

1. SEE = the standard error of the estimate.
2. AR, LA, OK, TX.
3. AL, FL, GA, KY, MS, NC, SC, TN, VA, WV.

TABLE 14--ERROR ANALYSIS, VISUAL RANGE CALCULATIONS FOR CLASS I AREAS, BNL's LONG RANGE TRANSPORT PREDICTIONS (Miles)

Lab Region	Sample Size	Mean Obs.	Mean Calc.	BIAS	SEE[1]
ANL	10	34.2	55.2	21.0	24.1
BNL	6	29.2	27.3	-1.89	7.63
LBL	30	39.7	44.6	4.95	5.24
LASL	57	62.7	64.4	1.68	2.56
ORNL-I[2]	6	29.6	31.0	1.40	1.75
ORNL-II[3]	20	13.5	15.2	1.69	5.77
PNL	25	35.9	38.3	2.40	2.45
All	154	43.0	46.6	3.54	7.28

1. SEE = the standard error of the estimate.
2. AR, LA, OK, TX.
3. AL, FL, GA, KY, MS, NC, SC, TN, VA, WV.

PNL regions. There is a large bias for the calculation of b and V in the ANL region. In the ANL region, 8 of 10 sites are located near the Canadian border in the Dakotas, Minnesota, and Northern Michigan. The large biases for the ANL region could be due to sulfates from Canadian sources not being accounted for in the long range transport calculations. They could also be due to the observed values not being representative of the true values. The number of observation sites for visual range were sparse in the region of the Dakotas, Minnesota, and Northern Michigan. The correlations between calculated and observed values for all regions and all cases were .906 for b and .958 for V. The higher regional means for V and the lower ones for b for the Class I area data as compared to the monitoring site data are due to the Class I areas being located in more remote, cleaner parts of the regions than are the monitoring sites.

The errors in the western Class I area calculations are larger for those based upon PNL's long-range transport predictions as compared to those based upon BNL's. This is because the errors mostly reflect the errors in the nonapportioned extinction. Industrial process sources in the west, modeled by PNL, account for a much greater proportion of the sulfur oxide emissions and the extinction in the west than do the industrial and utility boilers, modeled by BNL. Thus, a greater proportion of the nonapportioned extinction was modeled by PNL in 1977 than by BNL in 1975.

TABLE 15 -- ERROR ANALYSIS, EXTINCTION COEFFICIENT CALCULATIONS FOR CLASS I AREAS, PNL's LONG RANGE TRANSPORT PREDICTIONS (10^{-4} Meters^{-1})

Lab Region	Sample Size	Mean		BIAS	SEE[1]
		Obs.	Calc.		
LBL	30	.829	.534	-.295	.366
LASL	57	.398	.363	-.0351	.0823
PNL	25	.724	.570	-.155	.169
All-West	112	.587	.455	-.132	.214

1. SEE = the standard error of the estimate.

TABLE 16 -- ERROR ANALYSIS, VISUAL RANGE CALCULATIONS FOR CLASS I AREAS, PNL's LONG RANGE TRANSPORT PREDICTIONS (Miles)

Lab Region	Sample Size	Mean		BIAS	SEE[1]
		Obs.	Calc.		
LBL	30	39.7	57.1	17.4	18.3
LASL	57	62.7	69.1	6.40	11.7
PNL	25	35.9	45.1	9.16	9.54
All-West	112	50.5	60.5	9.97	13.4

1. SEE = the standard error of the estimate.

For the western Class I area calculations using PNL's long-range transport predictions, the total light extinction was underestimated and the visual range was overestimated, particularly in the LBL and PNL regions. This could result from the following cause(s): the sulfate concentrations due to the major industrial process sources were underpredicted; and/or the apportioned extinction due to non-sulfate aerosols and sources other than the major industrial process sources was underestimated. The correlations between calculated and observed values for all western regions and cases were .948 for b and .876 for V.

SUMMARY AND CONCLUSIONS

Visual air quality is most sensitive to degradation in areas with good visibility. The protection of visual air quality in mandatory Class I Federal areas has been declared a national goal by Congress. This study has evaluated potential impairment in visual air quality due to future energy development as projected by the Mid-Mid Energy Scenario. The light extinction coefficient and visual range have been used as indices of visual air quality. Light extinction coefficients for 154 Class I areas have been calculated from long range transport predictions of particulate sulfate and primary particulate concentrations, relative humidity data, regional emission and extinction budget factors, and estimated scattering to mass ratios. Scattering to mass ratios for Fine Particulate Matter (FPM) and for Total Suspended Particulates (TSP) excluding FPM were estimated using linear regression analysis.

A first cut was made at determining criteria for rating visual air quality impacts due to both regional haze and plume blight conditions. For the assessment of the scenario, it was assumed that sulfur dioxide and primary particulate emissions are effectively controlled through SIP, NSPS, and BACT regulations.

Impacts on visual air quality due to regional haze were predominantly low for the 154 Class I areas. Fifteen Class I areas were projected to have moderate to high impact due to regional haze. Seven Class I areas in the Rocky Mountain states were identified as having potential for impairment due to plume blight. Installation of sulfur dioxide control technology on copper smelters in the southwest could improve the visual air quality there, particularly in the southern part of the region. The error analysis indicated very good agreement between observed and calculated values of visual range and light extinction.

Information on coal-fired power plants under construction or permitted indicates that more capacity will be sited in the Rocky Mountain states than projected by the Mid-Mid Scenario. This will mean a greater impact on visual air quality will occur due to these sources than projected for this scenario.

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Visual Resource Management of the Sea[1]

Louis V. Mills Jr.[2]

Abstract: The scenic quality of the marine environment has become an important concern for the design and planning professions. Increased public use of the underwater environment has resulted from technological advancements in SCUBA, recreational submarines and through development of underwater restaurants and parks. This paper presents an approach to an underwater visual resource assessment with a case study example of St. Croix, U.S. Virgin Islands. Key seascape dimensions discussed are: water clarity, color, topographic relief, water depth, marine life and historic values. This assessment system provides a mechanism for the inclusion of scenic values in marine resource and planning inventories.

INTRODUCTION

The scenic quality of the sea has attracted mankind's interest from ancient times. Until the 20th century, the undersea environment has been dealt with, by the majority of people, only in fantasy works from Jules Verne and other imaginative authors, fisherman or naval experts. As a result of inventions such as SCUBA gear, submarines, off-shore drilling rigs and ocean mining apparatus, the marine environment has become an active arena for man's expansion and exploitation for resource recovery, recreation and even habitations.

Visual resource management of land and coastal environments has received extensive planning and design research. The management of the visual resources of the marine environment has been a rare topic. It is only as recently as 1943 that practical SCUBA gear was developed by Jacques Cousteau and Emil Gagnon and not until the 1960's that the first underwater trail/marine park in St. John was designed and constructed (Figure 1*). Presently, such ventures as underwater observations/restaurants have been constructed. The development of submarines for military and research purposes was initiated during the Civil War. Limited recreational usage of submarines was begun with "Theme Parks" in the 1960's. It is not beyond reasonable belief that extensive recreational use of submarines will occur beyond the "Disneyland" level. Such increased use of the marine environment demands that attention to the change and management of the visual resources be addressed.

ADVANCES IN AQUATIC TECHNOLOGY

Historically, there were three motivations for exploring the undersea environment: for food, for treasure and for military operations (Larson 1959). Presently, recreational and environmental aspects have become major attractions for marine travels. It is reported that in 1575, Alexander the Great descended to the ocean bottom in a diving bell. Until 1771, the diving bell was the sole apparatus for penetrating the undersea world. After 1771, man was a diver, as opposed to a swimmer, with the development of helmet/hose diving apparatus. With this equipment, connection to surface operations was mandatory for the man in the sea. In 1876, Henry Furness, a British mining engineer, developed a self-contained, close-circuit, underwater breathing apparatus (SCUBA). During World War I, a major use of the device was by the military in submarine warfare. In 1918, the first reported sinking of a ship from the British Navy by Italian divers occurred.

The publication of Jules Verne's Twenty

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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*See color illustration on page 399.

Thousand Leagues Under the Sea stimulated much public interest in the marine environment. In fact, in 1915, Verne's book became the subject of the first underwater motion picture, shot by J.E. Williamson (Larson 1959). In 1912, the first recreational reference to diving appeared in print in relation to a submarine sled, "....the advent of a new sport, that of submarine travel, may be forseen for the very near future" (Davis 1912). But it was not until the development of Cousteau and Gagnon's open-circuit SCUBA device in 1943, that extensive recreational use of the undersea environment occurred.

As the public use of the marine environment geometrically expanded in the 1950's and 1960's, pressure for establishment of marine preserves increased. Concentration of divers, fishing operations and other human activities in particular areas caused a deterioration in the quality and diversity of marine and benthic organisms. Collection of shells and coral, spearfishing and capture of tropical fish for aquariums overloaded the replacement ability in certain marine areas. This encouraged public statutes to protect the marine life and environment for certain pristine areas.

MARINE PARKS AND HABITATS

In 1960, at Point Lobos, California, on the Monterey Bay, the first marine state preserve was established. Shortly thereafter, President Kennedy gave federal protection to a marine area, Key Largo Coral Reef Preserve. The State of Florida, subsequently protected the nearshore area by establishing John Pennekamp Coral Reef State Park. From this point on, many states and other countries have established marine preserves and parks.

There appears to be two main types of marine parks: those with (1) sites having significant marine flora and fauna and (2) historic sites (Wamer 1978). The major purpose of these parks has been conservation. Lately, there has been an emphasis on recreational development. For example, the Trunk Bay Underwater Nature trail off St. John encouraged active public participation in the underwater world. Continual advancements in SCUBA gear have allowed mass involvement in the marine environment.

In 1962, Edwin Link in the Man-In-Sea Program initiated underwater living habitats with a one-day stay in the Mediterranean Sea. In 1969 and 1970, more publicized efforts were the two TEKTITE experiments at Lameshur Bay, U.S. Virgin Islands, lasting for 59 and 30 days respectively (NOAA 1975). As of 1975, approximately fifty undersea living habitat experiments have occurred worldwide. With such developments, it is obvious that a new era of exploration of the sea has emerged. These projects demonstrate man's ability to penetrate the ocean and stay for prolonged periods beneath the sea.

While these types of projects were primarily environmental and exploratory, similar projects of a recreational or commercial venture occurred. In 1968, a proposal for an underwater restaurant was submitted in San Diego for a 200-capacity lounge. Other sites being considered were: Los Angeles, San Francisco, Seattle, the South and the Pacific Islands. In 1977, St. Thomas, U.S. Virgin Islands, became the site for the first underwater restaurant/observation lounge in the Americas (Figure 2*). Other existing restaurants are located in Israel (Elat), the Bahamas and Japan. The site selection process for such commercial ventures is an excellent example of visual resources management of the sea.

These projects demonstrate the commercial value of beautiful seascapes and the need for protection and provision of accessibility to scenic underwater worlds and indigenous marine life. Important factors considered in site selection were: (1) number, variety and appeal of biota, (2) visibility, (3) bottom topography, (4) subsurface geology, (5) bottom sediment, transport patterns and rates, (6) currents and waves and (7) effects of seasonal variation. Other factors that are essential to commercial viability are: access to shore, availability of food and lodging, and location in regard to population centers (Mar Consult, Inc. 1971).

The development of marine underwater parks in recent years throughout the world has focused attention on the quality of the visual environment of the sea. There appear to be five main purposes for these parks: (1) perpetuation of unique marine ecosystems, biological and geological features and significant historical objects or sites, (2) protection of specific forms of marine life and habitats, (3) research and educational study of undisturbed marine environment, (4) recreation and (5) buffer zones (Wallis 1971). The visual resources of these parks seem to be an integral factor for each purpose, along with a broad range of other variables.

In the selection of sites for underwater marine parks or restaurants, visual quality is a key factor, but has rarely been addressed directly. Cultural resources such as historical sites, wrecks, sunken cities and fishing spots are relatively easy to identify. Natural resource inventories usually identify factors such as climate, geology, limnology and biology. Scenic factors, on the other hand, are not as easily addressed.

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*See color illustration on page 399.

UNDERWATER VISUAL RESOURCE ASSESSMENT

Conceptually, methodolgies for assessing the visual quality of the marine environment must take on radically new dimensions. Consideration of the perceptual framework and setting via SCUBA, skin-diving gear, or submarines is essential to the assessment system developed and applied due to dramatically different experiences and "viewsheds." While movement through landscapes is easy on foot, by car or plane; movement through waterscapes requires artificial breathing systems as well as transport systems. Because of the technical limitations, rarely does one sit to contemplate the view underwater as on land. Furthermore, movement through the sea is slow as compared to land transportation. Thus, the way one views and perceives seascapes is in an entirely different realm and requires a radically different approach than on land.

In landscape visual resource analysis viewsheds are a primary consideration for any study area. What one sees from the road, on foot, or in the air is critical. We don't really care about what we can't see; conversely, we encourage the screening of the ugly with fences, structures, or vegetation.

The view in the sea is determined primarily by factors such as: water clarity, one's speed through the water, lighting (artificial and natural), mode of transport, topography and flora. The physics of underwater sight and color perception is only beginning to be addressed (Drew et al. 1976). The identification of "viewsheds" can be mapped similarly to land analysis methods.

Perhaps the most important factor to be included in an underwater visual assessment method is clarity. However, of all the previously mentioned factors, this has the most variety and variability. In most diving accounts or tales, the quality of the water clarity is immediately addressed. Recreational diving usually occurs only during periods of good clarity for a particular area and most diving activity is concentrated in areas with good-to-excellent water clarity. In general, the range of good clarity is from 15 to 300 feet. Reasonably, the management of the visual resources of the undersea environment would be limited to such areas with good-to-excellent clarity. Logically, management of water clarity must be closely tied in to management of land use activities, construction and water quality programs (land-based).

Relative to viewsheds, the management of clarity can be accomplished relatively easily by empirically measuring sight distances vertically and horizontally or determination of light transmissivity of the water medium using a transmissometer. However, understanding the factors responsible for water clarity is a complex phenomenon involving water depth, surface and bottom currents, wind and wave storm conditions, tides, temperature, salinity, water quality (pollutants), flora and fauna productivity, surface runoff and many other parameters (General Research Corp. 1970). For planning and design purposes, it is logical to determine the range and mean of water clarity during peak user periods.

A ramification of existing aquatic technology is the significantly reduced scale of viewsheds. Much smaller viewsheds are experienced and perceived in the sea than on land. One just does not get "breathtaking" panoramic views as on land. However, what is lost in scale is perhaps gained in detail.

Color in the seascape is another important variable of scenic character. As with most landscape visual analysis, this parameter is indirectly alluded to in a descriptive manner and rarely in a quantitative way. While the intensity of light is easily measured by a light meter, the perception of the light and color diversity is another complex topic beyond the scope of this paper (Drew et al. 1976). Similarly, underwater photography must be approached completely differently than land photography.

Topographic relief can be readily quantified and included in undersea scenic character and quality analysis (Zube, et al. 1974). While a descriptive summary of topography and related geologic formations is an important factor, a quantitative measure of topography is critical to visual analysis. Topographic relief can be measured in a similar way to land environments, from nautical charts, yet again formation and scale of sea forms are in a different perceptive realm. Exciting dive locations are often at areas of dramatic change in topographic relief. The smaller scale relationships underwater must be considered; unfortunately, many nautical charts are at too gross a scale to indicate dramatic small scale topographic changes.

Water depth, related to topographic relief is another important consideration. While depth per se is not directly critical to scenic quality, indirectly it affects factors such as clarity, color penetration, flora and fauna. All underwater visual resource assessments should include depths of a study area because they relate directly to the kind of recreational use expected. In general the deeper one goes, the more critical and sophisticated are the life support systems required. Present day state-of-the-art recreational SCUBA is predominantly limited to less than 100 feet. Marine parks and restaurants have less of a threshold depth because of economic realities and linkage requirements to coastal areas.

Viewing the abundance and diversity of marine life is a primary incentive to go underwater. A factor that makes the seascape so unique is a very high concentration of marine life in certain areas as compared to that of life in most land habitats. A quantitative index for marine life both in number and type is useful in visual assessment. As with land fauna, there is a distinct nocturnal and diurnal change of behavior and activity in marine life. For this reason, night diving has become a popular recreational pursuit. Viewing marine life is easier than most wild land fauna types because one can approach much closer without inducing a fear/flight response. However, in areas of high spear-fishing activity, there is a distinct increase in this response for certain fish types. For obvious reasons, spear-fishing and collecting marine life are excluded in scenic marine parks and preserves.

Historical values should also be considered in an assessment study. Diving activities are often in areas with shipwrecks, sunken cities or structures, and sometimes in ocean dump sites or artificial reefs. While the motivation is often to collect artifacts and salvage value, a large factor is the scenic value. In addition, underwater structures, such as wrecks, oil rigs, and even discarded tires provide shelter and habitat for a large variety of fish and other marine life.

Identification of historic sites and structures is sometimes easy, since many wrecks in coastal waters are usually placed on nautical charts for navigational purposes. However, there are often discrepancies on precise locations of sunken ships on charts. The natural forces of the ocean rapidly corrode, bury or break up wrecks, so that the scenic value for historic sites often deteriorates quickly over time. Quantification of scenic value for historic sites is highly subjective except for indicating the presence or absence of such an amenity. For a seascape visual assessment, site-specific identification of historic areas or wrecks is a key factor.

There are many other variables that relate to seascape quality. A visual assessment study must be tailored to the particular kind of planning project or design concept. As human activities in the sea increase, more scenic variables would be encountered. Presently, habitations in the sea are still in the design stage, other than in an experimental manner, but are a likely future event. Design review of marine structures for aesthetic reasons is not a far-fetched idea. Environmental impact statements presently address such topics indirectly.

Part of the difficulty with seascape visual analysis is that almost no research has been undertaken. As recently as 1975, an attempt at developing a classification system for coastal and marine environments was carried out as part of the UNESCO Man and Biosphere Program (Ray 1975). It is unrealistic to expect sophisticated seascape visual assessment techniques without more basic research in understanding marine habitats.

Prior to assessment, a clear set of definitions and terminology for the seascape must be developed as has been done with the landscape (Appleyard _et al_. 1978). Closely related is the development of design principles of the seascape. Factors such as distance, observer position, form, spatial definitions, light and sequence of view should be included. Without comprehensive definitions of terms covering a variety of environmental situations and scales, the planner or designer is handicapped in justifying evaluative judgement.

VISUAL QUALITY ASSESSMENT: A CASE STUDY

The visual quality of the marine environment of the U.S. Virgin Islands has long received international accliam. _Skin Diver Magazine_, a leading diving publication, rates the waters for diving as "the most beautiful area in the world." It is not surprising that the Virgin Islands is the site for the first underwater trail, one of the first underwater parks in the world, and the first underwater restaurants in the Americas. On the other hand, dredging activities during construction of the largest oil refinery in the Americas (Hess Oil) decimated one of the most productive and largest mangrove lagoon areas in the Carribbean, and wiped out diving activities for half of the southern part of St. Croix. While substantial planning efforts have occurred in the Virgin Islands to protect the marine environment, deterioration of the pristine marine environment continues from factors of municipal sewage, industry, land development, fishing and recreational overload. For these reasons, improved management of the seascape is critical.

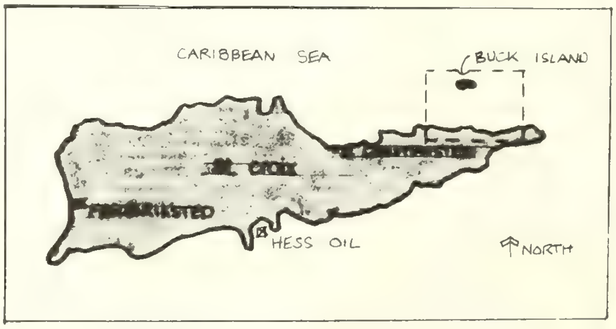
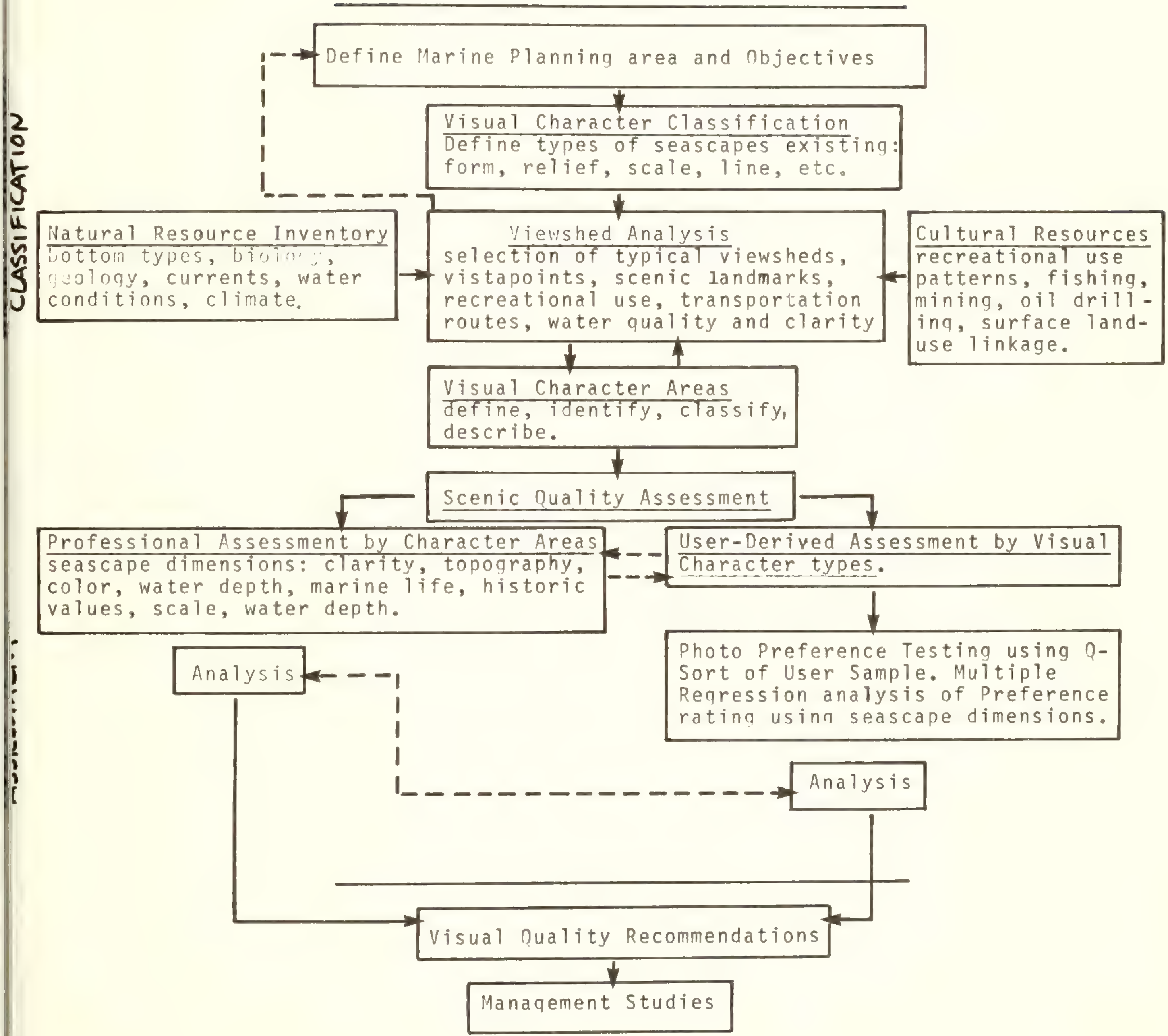


Figure 3--Site Location

Figure 4
SEASCAPE VISUAL RESOURCE ASSESSMENT


CLASSIFICATION
ASSESSMENT
Define Marine Planning area and Objectives
Visual Character Classification
Define types of seascapes existing: form, relief, scale, line, etc.
Natural Resource Inventory
bottom types, biology, geology, currents, water conditions, climate.
Viewshed Analysis
selection of typical viewsheds, vistapoints, scenic landmarks, recreational use, transportation routes, water quality and clarity
Cultural Resources
recreational use patterns, fishing, mining, oil drilling, surface land-use linkage.
Visual Character Areas
define, identify, classify, describe.
Scenic Quality Assessment
Professional Assessment by Character Areas
seascape dimensions: clarity, topography, color, water depth, marine life, historic values, scale, water depth.
User-Derived Assessment by Visual Character types.
Photo Preference Testing using Q-Sort of User Sample. Multiple Regression analysis of Preference rating using seascape dimensions.
Analysis
Analysis
Visual Quality Recommendations
Management Studies

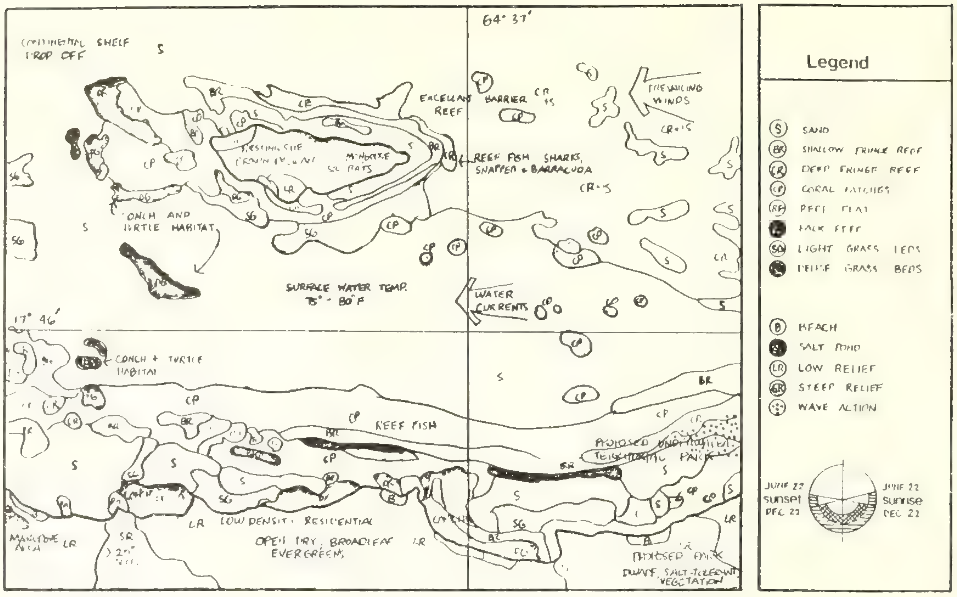


Figure 5--Land and Seascape Visual Resources

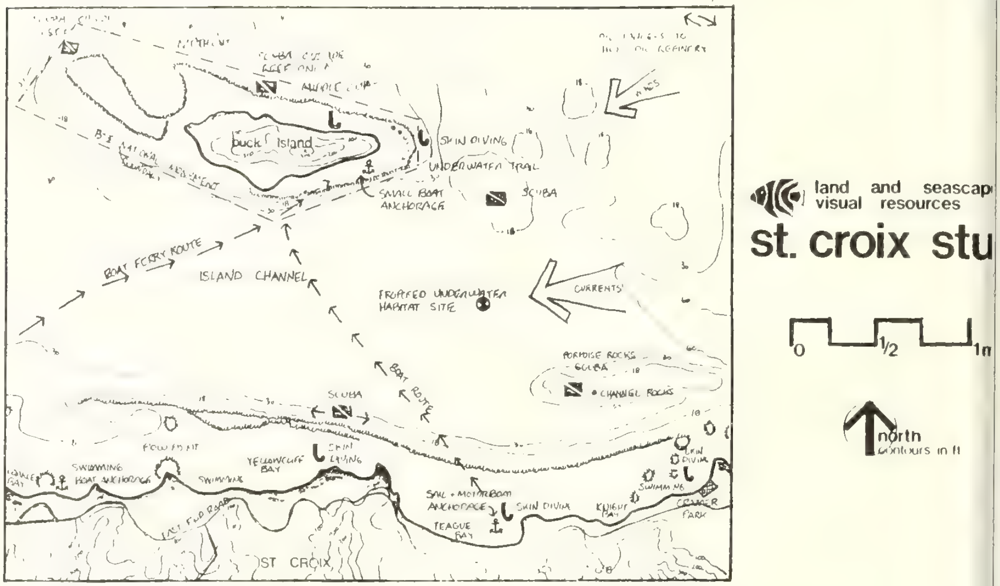


Figure 6--Natural Resources

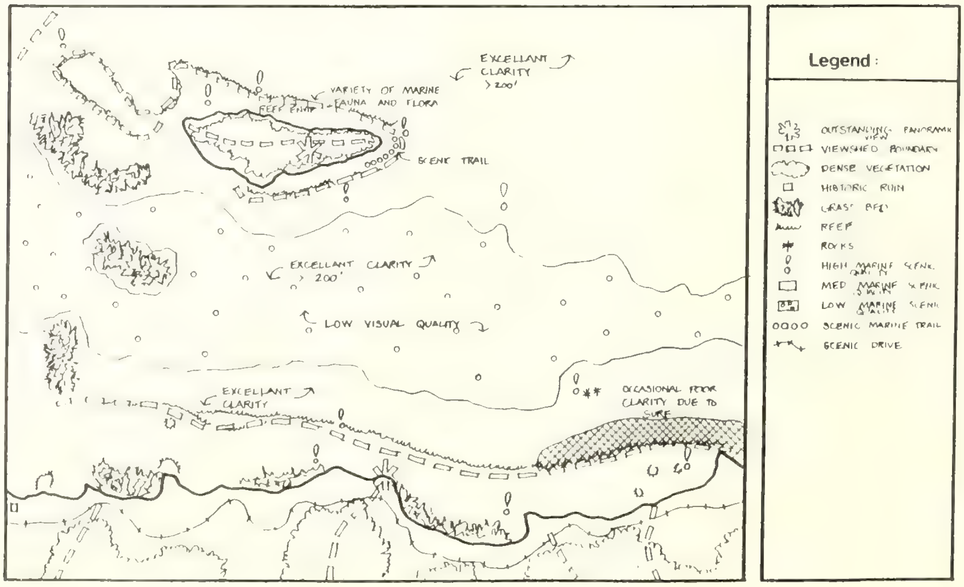


Figure 7--Recreational and Cultural Resources

The study area (see figure 3) includes part of the Buck Island National Monument (island and reef), a section of the north coast being considered for a marine park in the territorial park system and a research station of Fairleigh Dickinson University (West Indies Lab). The fringe reef along the north coast receives considerable recreational usage. The land and marine environment is still relatively pristine and could tolerate moderate development (another underwater park, underwater restaurant, etc.), if done in a manner sensitive to the fragile environment.

Figure 4 illustrates a methodology for visual resource analysis of the area and a means to incorporate the analysis in planning. There are three basic phases included: visual character classification, assessment and management. Because of time and funding, the management phase was not initiated in addition to the user-derived assessment.

Figure 5 presents a natural resource inventory. Data were collected from air photos interpretation, U.S.G.S. topographic maps, nautical charts, and my personal familiarity with the site as a member of the territorial Coastal Zone Management Staff. Unfortunately, no systematic site survey was undertaken to obtain "ground truth." The use of air photos is an invaluable planning tool for marine visual resource studies in areas less than 100 feet in depth. This study perhaps demonstrates the maximum limit for conventional air photos usage under existing technology because of the exceptional water clarity.

Recreational and cultural resources for the area are shown in figure 6. Diving information was collected through interviews with professional diving guides and marine biologists with the territorial Department of Conservation and Cultural affairs, in addition to my personal dives in the area. Strict management of Buck Island by the Park Service has kept it in pristine condition.

The visual resources analysis (fig. 7) combines both a visual character classification and quality assessment. The low visual rating (relative to the Virgin Islands) of the channel area is due to variability in topography, low diversity of marine habitats (mostly sand bottom) and low underwater recreational use. Conversely, areas of high quality were identified due to a combination of factors and high component value for water clarity, topographic relief, marine life, history and recreational use.

The assessment system is at a very gross scale of rating. A more precise rating would be ideal if user-derived values were available and basic research was completed in underwater perception of visual quality. With visual ratings, one can then assign priorities to planning and design objectives and implement a management program of protection, enhancement or rehabilitation for the area. In the case of St. Croix, preservation and strict management of all viable reefs and grassbeds is a primary objective, since these are the major visual resources of its marine environment.

CONCLUSION

The future use and management of the marine environment is wide open to the design and planning professions. While the scope of this paper has been on marine visual resource analysis, a significant and related factor not addressed is environmental quality. According to Jacques-Yves Cousteau: "..... We divers are witnessing the demise of the precious wilderness we discovered" (Cousteau 1978). While tremendous allocations of money have been applied to space research, marine research and development has been neglected. The realm of management of the visual environment of the sea is a new frontier.

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Designing Future Landscapes from Principles of Form and Function[1]

Larry D. Harris and Patrick Kangas[2]

Abstract: Future landscapes will consist of a gradient of types ranging from wilderness areas to totally "humanized" environments. The man-dominated landscapes will be required to fulfill multiple functions only one of which is aesthetic enjoyment. It is suggested that basic principles of form and function may contribute to design criteria. Applications to the southeastern forest landscape are being pursued.

INTRODUCTION

Volumes have been written about man's detrimental impact upon his surroundings. However there are still a variety of aesthetically appealing landscapes existing today. These landscapes range from relatively natural scapes coveted by wilderness users to the various "humanized" environments, created to fit the physiological and emotional needs of more "modern" man (Dubois 1976). Yet there is little doubt that man is creating new and perhaps less desirable, environments and landscapes. Florida and other "sunbelt" states are especially impacted by human population growth and development issues. As fossil fuels dwindle and the residential utility bills skyrocket in the Northern states there seems little reason to expect a change in trend.

Approximately 8000 new immigrants settle in Florida each week (≃ 400,000 per year). Assuming a per capita land development of 5 acres for residence and public and private support facilities (e.g., transportation, shopping and service centers), approximately 40,000 acres per week or 2 million acres per year must be developed. In 1973 one of every seven new houses built in the United States was built in Florida. Other land uses are equally compelling. Along with North Carolina, Florida produces approximately 80% of all domestic phosphate consumption. Florida alone produces approximately 80% of the North American phosphate exports and ranks second only to Morrocco as an International producer. In spite of the above, Florida remains a rural state. With over 16 million acres of commercial, short rotation forest land, Florida is an annual leader in acres reforested. In total, these factors create the prospect of leaving future generations with an unplanned environment by default. They also create the opportunity for planning and perhaps designing a more livable future environment. It is the purpose of regional planners to design future spatial and temporal patterns that optimize the mix of functional ecosystems as elements. Aesthetics and visual appeal must occupy a critical position in these designs. On the other hand there will be little opportunity for designing aesthetics into the landscape unless functional utility is considered first. We believe that basic notions of ecological and general systems theory are highly apropos.

THE CONCEPT OF REGIONAL SYSTEMS

Central to ecological and general systems theory is the principle of emergent properties. This principle asserts that certain properties only emerge or become identifiable with a level of organization when viewed from a higher level. In other words, the whole is greater than the sum of the parts. For example, even though life can be reduced to a series of physical-chemical processes it is known to possess attributes which cannot be explained or predicted by physics and chemistry. Similarly, populations can be reduced to collections of individuals and yet many population phenomena can not be explained as organism responses. Although we often treat lichens as organisms and even assign them scientific names as though they were simple species, we know full well that their properties result from a unique interaction of algae and fungi.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resources, Incline Village, Nevada, April 23-25, 1979.

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The principle of emergent properties is based on the premise that constituent elements add together functionally and synergistically. Individual elements play specific functional roles and by so doing, the whole takes on characteristics beyond to the properties of the parts. A forest is more than a stand of trees and landscape is more than a collection of scenes. Future landscapes designed with regional purpose and balance in mind must consist of integrated functional elements. When they do, the regional system will exhibit emergent properties such as beauty and ecological stability.

Waddington (1951) has observed that any reasonably astute adult walking along a beach and encountering objects of debris would have little difficulty distinguishing man-made from natural artifacts. He goes further to suggest that the principal reason is that man-made products have been designed with a single purpose in mind. To the contrary, natural selection operates on a multitude of criteria simultaneously and therefore blends and integrates form with multiple function. The form of designed landscapes must eminate from a multitude of simultaneous functions.

FUNDAMENTAL BIOLOGICAL FORMS

The descriptive relations between form and function are well established in the basic biological science such as botany and zoology (Portman 1967, Thompson 1961). For example, given relatively similar ecological niches or roles in geographically isolated ecosystems, organisms of greatly different evoluntionary background frequently develop similar forms. Although no useable synthesis or application above the organisms level has been made, the approach seems clear and rewarding. Given that we can articulate the ecological functions required of the regional landscape we believe we can draw upon certain universal forms for their achievement. We cite three simple examples.

The dendritic pattern (Fig. 1) is common to both plant and animal kingdoms. Root systems, nervous and circulatory systems and many taxa of lower organisms are organized on the basis of this pattern. To the extent that correlative analysis is valid, the function associated with this form is almost universally collection, concentration and/or distribution of elements or resources. The logical extension of this basic biological principle to the landscape is illustrated by regional drainage patterns. This is not only obvious in the concentrating reaches of the headwaters but also in the dissipating network of many river deltas. We conclude that many of man's more recent large-scale development schemes could profit from obeyance of such a simple natural landscape pattern.

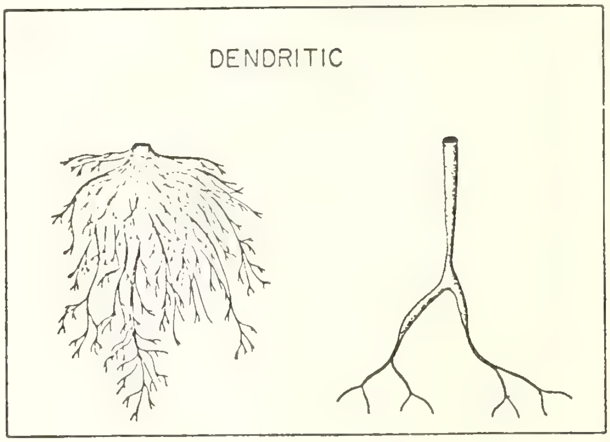

Figure 1--The Dendritic pattern so common throughout the plant and animal kingdom is also known to apply to the upper reaches of river systems as well as the lower reaches wherever delta formation is prominent. Its primary function is that of collecting and/or dissipating water and nutrients.

A second form that pervades much of biology is the convoluted form (Fig. 2). This form dominates gastro-intestinal tracts, lungs, gills, baleens and compound leaf structures. The almost universally associated function is interchange of substances, either nutrients, gasses or heat. We perceive a landscape extension of this fundamental notion as the use of graded curves in high relief highway engineering (e.g., dissipating high amounts of potential energy from an auto on a steep incline) and meanders in fluvial geomophology. There is currently considerable interest in applying this principle in agronomic landscape design for pest control (Plank 1960).

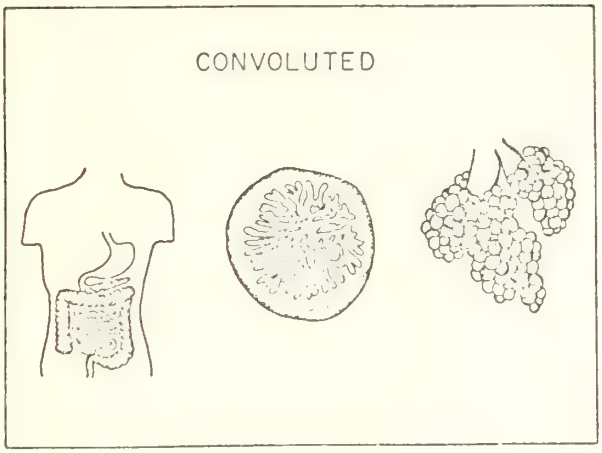

Figure 2--The convoluted form is common at the organ and organ-system level of hierarchy and is also known to apply to certain phyla of organisms. Margalef (1968) suggests that ecosystem boundaries follow this pattern to greater or lesser degrees depending on the amount of exploitation occurring.

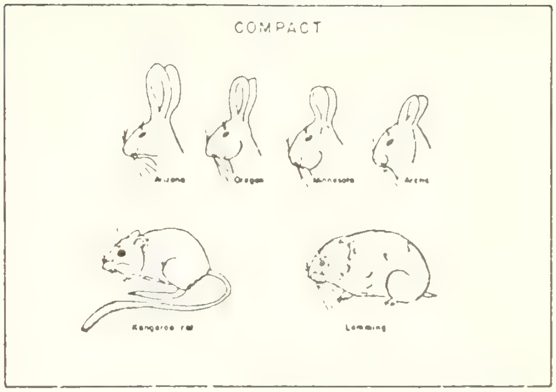

Figure 3--The compact form referred to in animal ecology as Allen's Rule is associated with conservation of resources such as energy and the defense of boundaries. This form would be appropriate for field plot designs and related landscape units where a minimum edge to area ratio is desirable.

The convoluted ecosystem form has been identified as a correlate of spatial ecosystem interaction. Margalef (1968) asserts that: "A more mature system always exploits a less mature system" and that this exploitation occurs at the boundary or interface between the two adjoining systems. Therefore, it is to the advantage of the mature system to maximize the amount of boundary convolution and thus interchange capacity.

A third form well known to biologists is the globular or compact form (Fig. 3). Allen's Rule from animal ecology notes that as average ambient temperature gets colder, appendages of warm blooded animals get smaller. In this case, conservation of heat dictates minimum surface to volume ratios. Several other disciplines have shown that this principle also applied to minimizing the boundary to be defended (e.g., military strategy). Needless to say, this form is the opposite of the convoluted form so essential to heat dissipation or exchange. Indeed Margalef (1968) asserts that in less mature communities the trend must be to reduce to the minimum the potential sites of exploitation. Certain primitive cultures driven by the necessity to defend territorial boundaries yet maximize overall use of the landscape developed their political units in a hexagonal pattern (Woldenberg 1976). The hexagon is the geometric form that minimizes the boundary of individual elements while maximizing their packing at the landscape level.

REGIONAL LANDSCAPE FUNCTIONS

The question quickly becomes whether or not the principles and lessons learned from the basic biological sciences can be extrapolated to higher levels of organization such as the ecosystem or regional landscape. We are confident they can. As ecologists we believe there are critical ecological functions to be performed within the regional landscape. These are analogous to natural ecosystem functions so well studied in this decade. The support of heterotrophic organisms such as humans requires basic primary production systems. Moreover, since solar energy, the basis for most primary production, is so dilute this primary production function runs the risk of having to be massively extensive. The obvious alternative is to complement and amplify the solar energy with other types of energy such as fertilizers, pesticides and fossil fuels so that the high energy, primary production units of landscape can be reduced in total extent.

Major functions likely to be required of regional landscape systems are:

Production Systems (Fields, forest, animal systems)

Recycling Systems (Sewage, solid waste)

Decomposition Systems (Landfill, cemeteries)

Abatement Systems
- Stress abatement (Recreational areas)
- Pollution abatement (Primary, secondary, tertiary)
- Heat abatement (Thermo-nuclear)

Storage Systems (Housing, etc.)

Water Systems (Retention, storage, conservation, recycling)

Reservation Systems (People, wildlife)

The task at hand is to integrate these and related ecological functions and implement basic planning designs that achieve the desired performance of the regional landscape. We believe that basic biological forms will play vital roles in these designs. We encourage future planners to build upon the ecologically-based precedent set by McHarg and draw from the inventory of form and function relationships well known to biology. Our own efforts are presently directed at the design of the southern coastal plain forested landscape.

THE FUTURE SOUTHERN FOREST

Presently there are slightly over 200 million acres of forested landscape in the American Southeast. Over 700,000 acres are currently being replanted to southern yellow pines (Pinus spp) annually with an expected interval of 25 years to maturity. This southeastern forest yields about 60 percent of the national pulpwood supply. The pulpwood demand projections for the year 2000 anticipate southeastern production of about 100 million tons per year. This value is perhaps 70 percent greater than the current annual growth increment. An additional 30 million acres would be necessary to meet this demand at current production rates. But this is unreasonable since competition for forest acreage is intensive. In Florida, for example, over 200,000 acres of forest land are lost to competing uses each year. The more likely outcome is that future forests will be managed more intensively for pulpwood;and related uses such as recreation, water management and residence will need to be designed into the forest landscape.

The specific functions required of the forested landscape are fiber production (both pulpwood and biofuel), high quality water yield, pest control, wildlife production, aesthetics and related recreational benefits.

Since forest stands interact at their boundaries, the spatial distribution of stand types is critical to the achievement of an integrated synergistic design. The variables of spatial design include size, shape and ratio of ecosystem elements and the emergent pattern created by their boundaries. The amount of edge drama (i.e.,the structural difference) between adjacent ecosystems is an additional variable that governs the interaction of the stands as well as dictating the emergent pattern (Harris and Smith 1978). By building upon these concepts we are developing design principles for the future southern forest. When functional interaction of the component ecosystems is achieved the overall landscape will be more productive and stable than simple random combinations.

Specific parameters allowing us to evaluate the relative worth of different time-space mosaics are *i*) heterogeneity and functional diversity, *ii*) the degree of interspersion, *iii*) the linear extent and type of edge, and *iv*) edge drama or juxtaposition.

SUMMARY

The future environment will necessarily serve multiple functions. Although aesthetics is a critical consideration to most of us, it is but one of many functions required of the regional ecological system. We believe the landscape level of hierarchy has been neglected by the disciplines of ecology and planning to date. It remains a vital level of concern. By coupling basic principles of form and function with the demands of future society we may leave behind a planned rather than a default environment.

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People, Planners and Policy: Is There an Interface?[1]

Susan J. Kopka[2]

Abstract: This research attempts to isolate some of the dimensions of human evaluations/perceptions of the built environment through the use of an Audience Response Machine and a video tape of environmental scenes. The results suggest that there are commonalities in peoples' evaluations/perceptions and that this type of inquiry has prescriptive value for design/planning.

INTRODUCTION

The impetus for this paper comes from three major sources. The first of these sources is the author's interest in the planning and design of environments. The theoretical/disciplinary biases of the paper are landscape architecture and natural resource planning and policy.

The second source of stimulation comes from the researcher's interest in the area of evaluation of environmental/behavioral contexts. This area falls within the discipline of environmental psychology (Rapoport 1977, Porteous 1977).

The third and final provoker was the discovery of a "tool" applicable to the analysis of the above two areas of inquiry: an Audience Response Machine. With the methodology provided by the Audience Response Machine this paper constitutes an empirical inquiry into the potential interface between landscape architecture, environmental psychology, and natural resource planning and policy.

THEORETICAL FRAMEWORK

The Man-Environment Model

The discussion of the theoretical base for this empirical pilot study must begin with a notion of the man-environment model. The basic assumption of this model is that human and environment systems are mutually dependent and have mutual effects upon one another. The inherent "tension" in the relationship places control in both the human and natural components. In addition, the human system has an element of responsibility if the relationship is to continue. Until the late 1960's this emphasis upon human responsibility and cooperation did not exist in popular discourse (Miller 1975, McHarg 1971). With the advent of the 60's and the NEPA[3] came a realization of the increased pressures that man and technology had been placing on the environmental system. The American society as a whole became more aware of its interactions with nature, and the evaluation of the man-environment context became increasingly more important. Yet even today, some ten years hence, there are varying opinions on most environmental issues. Variance exists between those who make policies concerning the environment, and those who actually live within the environmental context for which the policy is being made. This discrepancy between the "public" and the planner/designer conceptions of the environment is the topic of exploration in this study.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Landscape Planner, Planning Resources Incorporated, Cleveland, OH.

[3] National Environmental Policy Act, 1969.

This discrepancy involves, what is known in the field of environmental psychology, as "environmental evaluation" or "environmental perception" (Rapoport 1977, Ittelson, Proshansky et al 1974). The discipline of environmental psychology is an off-shoot of some more established disciplines like psychology and sociology. The field's emphasis lies in the ramifications of built environments on human cognition, perception and behavior (Michelson 1976, Newman 1973). Its most admirable contribution is its search for a union between the theoretic aspects of sociology and psychology and the applied aspects of design and planning. The man-environment interface is clearly multifaceted. Environmental psychology with its multi-disciplinary focus may provide greater outcomes for the community of man.

Environmental psychology embodies the philosophy that people behave in certain ways as a result of the social and physical settings within or through which they move. Much of the research in this area has been descriptive in nature; phenomena are described as they occur and the researcher then tries to attribute behaviors to certain environmental causes which are based on past theoretical frameworks (Ittelson,Proshansky *et al* 1974). The merits of this field lie in its prescriptive abilities. If we can understand how and why people behave as they do in different settings, we can begin to design better environments: environments that reflect peoples' needs and wants.

Few studies have been done in this area which center their research interests on the prescriptive value of environmental psychology. Since much of the designers and planners' work is done in the areas of policy and, since policy is a process involving evaluation, this type of research approach was of interest.

Planning and design can be seen as "choice processes" which attempt to produce a single solution from numerous alternatives. This elimination of alternatives involves the application of criteria. What are the criteria and where do they come from? All man-made environments are a result of many decisions made by the inhabitants and outside "experts." Decisions are made as a result of conflicts between "value states," i.e., the process of evaluation of positively and negatively weighted variables (Rapoport 1977). People try to match their values, norms, expectations and experiences with environmental settings. Examples of this would include the processes of design and human migration. The design of an environment involves the "encoding" of information by the designer, such that the users "decode" the information in the expected manner. If the symbolic nature of the coding system is not understood there will be break-downs in the system: the design or plan will fail or be improperly used. "Important is the need to achieve congruence with some ideal, so as to maximize a set of ranked values" (Rapoport 1977). In many cases this has proven impossible. Frequently, too many "multiplicative and idiosyncratic images" or ideals exist for any setting and any given group of users (Rapoport 1977, p.17). Clearly, design criteria must in some way embody the values and norms of the prospective users or the design outcome will be at best less than satisfactory. Mismatches between initial values and ultimate plans/designs usually result from the void between designer/planner and the user (Rapoport 1977).

The dimensions of evaluation and perception are of paramount importance in understanding peoples' reactions to environmental contexts. The perceptual system is concerned with experiencing the world; evaluation refers to the affective or expressive system where things are assigned values. The process of perception involves selecting from the environment those aspects which match one's images of the way things should be or are.

This research study is a pilot attempt at looking into what it is that people like and dislike, think is aesthetic and unaesthetic and what they find to be exciting and unexciting about built environments.

The few studies attempting to develop methods for tapping the components of environmental evaluation fail to offer concrete directions for design and policy (Rapoport 1977). For this reason, this study does not claim to be anything more than a pilot. The findings are not meant to be generalized. The study is interested in the use of a specific measuring tool: the Audience Response Machine (A.R.M.) and its role in the tapping of the environmental evaluation process.

DISCUSSION OF RESEARCH PROCEDURES

An A.R.M. was employed in measuring the values people place on the environment. The A.R.M. is a mechanical tool for measuring responses to visual stimuli. It has been used most widely in the areas of communication and audience behavior studies. The system was first introduced to the field of Landscape Architecture by Banerjee *et al*.(1977), who did a study involving an I.R.P. Recorder (Instantaneous Reaction Profile; analogous to the A.R.M.), in which their principle interests centered around people's reactions to coastal scenes in California. Although their findings were less than conclusive, they did substantiate the usefulness of the tool for policy decisions.

Measuring Instrument

As was mentioned previously, the A.R.M. measures subject responses to visual stimuli: films, slides, video tapes, etc. In this study, subjects were seated in a "living room laboratory"[4] where each of them had an individual recording console with five buttons on it labelled A through E.

Three independent groups of subjects were asked to respond to a video tape of environmental scenes by pressing appropriate buttons on their recording consoles. Table 1 presents the coding schemes each of the three groups employed.

Table 1--Coding Schemes for Three Subject Groups

Group Number	Recording Console Button Labels				
	A	B	C	D	E
1	Strong Like	Like	Neutral	Dislike	Strongly Dislike
2	Highly Aesthetic	Aesthetic	Neutral	Unaesthetic	Highly Unaesthetic
3	Very Exciting	Exciting	Neutral	Unexciting	Very Unexciting

Each subject's responses to the visual stimulus were recorded as they occurred in response to the stimulus and were printed on a computer printout.

All subjects reacted to the same visual stimulus but their reactions were within one of the three categories mentioned before, depending on the group in which they were placed.

Stimulus

The video tape used as the stimulus for this study was produced by this researcher with the use of a portable video tape recorder. The video tape consisted of twelve 70 to 75 - second views or pans. These "pans" were of environmental scenes. The environmental scenes were not chosen at random, but rather were chosen with an intent to provide as much variance in environmental scenes as possible. The video tape was in black and white and lasted approximately 12 minutes. Included in the Appendix of this paper are written descriptions of each of the pans . In addition to the visual dimension to the tape, auditory aspects of each pan were also recorded. In the descriptions the character of the sounds in the pans is also included.

Subjects

The subjects used in this study were college students ranging in age from 18 to 25. Their academic standings ranged from freshman to graduate student. There were 31 total subjects; 10 females and 21 males. The subjects were solicited for the study informally through word of mouth, signs, and flyers around the university community. They were asked to participate in a study which would take 1 hour of their time. The participation was totally voluntary. The 31 subjects arrived at their convenience and were randomly assigned to one of the three subject groups. Ultimately, there were 10 subjects in the Like/Dislike and Aesthetic/Unaesthetic subject groups and 11 subjects in the Exciting/ Unexciting subject group.

Questionnaire

In addition to responding to the visual stimulus through the manipulation of the A.R.M., the subjects were also asked to fill out a 50 item questionnaire after they had viewed the video tape. The questionnaire was employed for the purpose of tapping demographic data for use in subject profiles, and secondly, to test the subjects' ability to recall visual and auditory aspects of the video tape. The questionnaire consisted of a list of items to which the subjects responded "yes" or "no" to recalling from the video tape. The list included some false items which were randomly mixed in with the true items. The true items were originally retrieved from the video tape by the researcher; the false items were made-up. The demographic items on the questionnaire were: age, sex, and academic status. Total correct scores for each subject were calculated. An item analysis was also performed.

Methods of Analysis

There were three main methods of analysis used in this pilot study: an item analysis on the questionnaire, cross tabulations on data from both the computer printouts (A.R.M.) and total scores from Recall questionnaire; and finally, a number of graphic displays of data, taken from the A.R.M. data and the questionnaires.

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[4] The Communication Research Laboratory at The Ohio State University was employed in the research.

For ease of interpretation the Likert categories for each of the three subject groups were collapsed into three categories (High, Medium, Low). This was done by dividing the range of subject scores on the pans into thirds. Scores falling in the lower third were placed in the Low category, the upper third were placed in the High category and the remainder in the medium category.

After reviewing the computer tapes of the subject responses to the video tape it was decided that the response sequences in the first pan showed insufficient variance and were dropped from the analysis. This lack of variance was probably due to a "training effect." Subjects were still familiarizing themselves with their A.R.M. consoles and hence were not pressing buttons.

FINDINGS/RESULTS

The results are displayed both graphically and in tabular fashion. Figure 1 displays a plot of the grand means for each of the eleven stimuli (pans). The dotted line represents the Exciting/Unexciting category, the dashed line the Like/Dislike category and the continuous line the Aesthetic/Unaesthetic category.

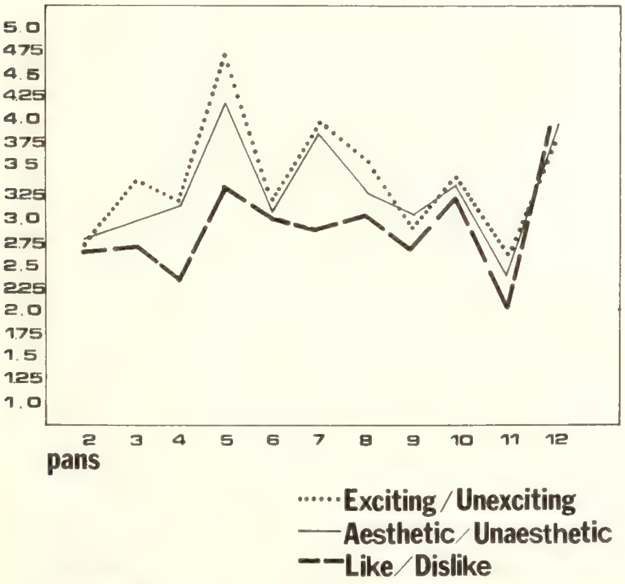
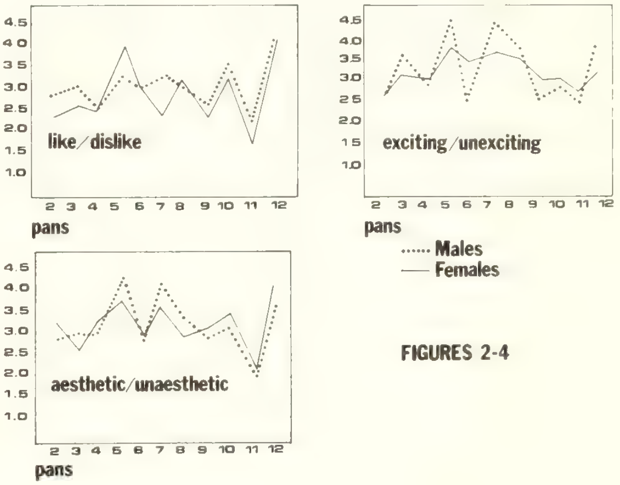


FIGURE 1

Elements of interest in Figure 1 are the covarying plots of the Exciting/Unexciting and Aesthetic/Unaesthetic categories and the more independent Like/Dislike plot. It appears that two independent dimensions of environmental evaluation were tapped: a Like/Dislike category and a category of Exciting/Unexciting - Aesthetic/Unaesthetic. Pans 4 and 11 were the most well-liked and were also among the most exciting and aesthetic pans. Both of these were characterized by less offensive audio dimensions and a dominance of pleasing visual imagery. (See Appendix for pan descriptions).

Figures 2-4 present each of the three treatment (category) groups broken down by sex of respondent. The continuous line represents females and the dashed line males. The greatest difference between female and male evaluations was in the Exciting/Unexciting category. In this category, male and female responses differed the most in their responses to pans 6 and 7. In both instances the males found these pans to be more exciting than the females. This is interesting since pan 6 is of The Ohio State University golf course and pan 7 is of the campus area. Perhaps the males were more familiar with both of these scenes than were the females.



FIGURES 2-4

Cross-tabulations of age by Mean Score (collapsed across the three category treatments) for all stimuli (pans) and sex by Mean Scores for all stimuli were calculated. (See Appendix, Tables 2 & 3). The general results of these cross-tabulations suggested that regardless of age most subjects, 63 per cent, found the stimuli to be somewhat less than neutral in appeal and that sex was not a discriminating variable in terms of the overall level of appeal of the stimuli (pans).

Table 2--Grand Means For Pans Collapsed Across Categories

Age	Score Low (≥ 3.1)	Medium (3.09-1.79)	High (≤ 1.79)
18 - 19	6%	10%	3%
20 - 21	35%	6%	0%
22 - 23	19%	10%	0%
24 - 25	0%	3%	0%
25 & Over	3%	3%	0%
Totals	63%	32%	3%

*** Percentages are of the total sample. (31 subjects)

Table 3--Grand Means For Pans Collapsed Across Categories

Sex	Score Low (≥ 3.1)	Medium (3.09-1.79)	High (≤ 1.79)
Females	60% 19%	40% 13%	0% 0%
Males	67% 45%	28% 19%	4% 3%
Totals	64%	32%	7%

*** Top percentages are for row total. (Males or females)
Bottom percentages are for total sample. (31 subjects)
"Totals" is of the total sample. (31 subjects)

Some interesting results surfaced in the analysis of the Recall Questionnaire. Figure 5 is a graphic representation of the frequency distribution of correct responses for both male and female subjects. While the means and standard deviations of the distributions do not vary significantly, the appearance of the distributions does. The male subjects were much more volatile in their distribution of responses than were the females.

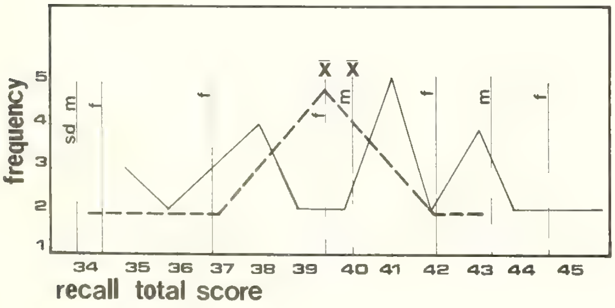


FIGURE 5

X̄ mean
s.d. standard deviation
--- Female (f)
—— Male (m)

Table 4 is a cross-tabulation of academic standing by recall score for females.

Table 4--Recall/Comprehension Questionnaire: Total Scores for Females

Academic Standing	Score High (≥ 40.7)	Medium (40.6-38.2)	Low (≤ 38.1)
Freshman	66% 20%	33% 10%	0% 0%
Sophomore or Junior	40% 20%	40% 20%	20% 10%
Senior or Graduate	0% 0%	50% 10%	50% 10%
Totals	40%	40%	20%

*** Top percentages are for row total. (Freshman, sophomore...)
Bottom percentages are for total sample. (31 subjects)
"Totals" is of total sample. (31 subjects)

Of interest in this table is the difference between the freshman total scores and the senior or graduate total scores; freshman had 66 per cent in the High category, senior or graduates had 50 per cent in the Medium and Low categories. Sophomores and juniors were fairly well distributed in their scores. Eighty percent of the females scored in the Medium to High range on the Recall Questionnaire.

A cross-tabulation of age by Recall Score was also calculated for females. It essentially mirrored the Recall by Academic Standing analysis.

Table 6--Recall/Comprehension Questionnaire: Total Scores for Females

Age	Score High (≥ 40.7)	Medium (40.6-38.2)	Low (≤ 38.1)
18 - 19	66% 20%	33% 10%	0% 0%
20 - 21	40% 20%	40% 20%	20% 10%
22 & Over	0% 0%	50% 10%	50% 10%
Totals	40%	40%	20%

*** Top percentages are for the row total. (Age groups)
Bottom percentages are for total sample. (31 subjects)
"Totals" is of total sample. (31 subjects)

The cross-tabulation of Recall Scores by academic standing for men is very similar to the cross-tabulation for female subjects. The freshman and sophomores tend to score consistently better than the juniors and seniors.

Table 5--Recall/Comprehension Questionnaire: Total Scores for Males

Academic Standing	Score		
	High (≥ 41.8)	Medium (41.7-38.6)	Low (≤ 38.5)
Freshman	50%	50%	0%
	5%	5%	0%
Sophomore	44%	33%	22%
	19%	14%	10%
Junior	22%	22%	55%
	10%	10%	23%
Senior or Graduate	0%	0%	100%
	0%	0%	5%
Totals	34%	29%	38%

*** Top percentages are for row totals. (Academic standings)
Bottom percentages are for total sample. (31 subjects)
"Totals" is for total sample. (31 subjects)

Table 8 cross-tabulates Average Pan Ratings with total Recall scores, as they differ between males and females. A Chi Square Test for Independence was used to analyze this particular Table (d.f. = 4, $X^2 = 4.057$, p .05). The Chi Square Test failed to reject a null hypothesis of "no difference within the table cells." While non-significant results should be interpreted with caution it appears that the frequencies of occurrence within the cells may be randomly occurring.

Table 8--Recall/Comprehension Questionnaire: Total Scores for Males & Females

Average Rating Score For Pans	Score		
	High (≥ 41.4)	Medium (41.3-38.5)	Low (≤ 38.4)
Low (≥ 3.1)	23%	23%	19%
Medium (1.79-3.09)	6%	16%	13%
High (< 1.78)	0%	0%	0%
Totals	29%	39%	32%

*** Percentages are of the total sample. (31 subjects)

Finally, the item analysis of the Recall Questionnaire indicated an interesting aspect involving the auditory dimension of the video tape. There were four auditory items on the questionnaire: 12, 30, 33 and 40. The item analysis indicated that those people who scored the lowest on the Recall Questionnaire were nevertheless able to recall three out of four of the auditory items; a better recall rate than those with higher overall scores. Auditory items 12, 33 and 40 were the most frequently recalled by this select group; these were car horns, birds singing, and a train whistle, respectively.

CONCLUSIONS AND RECOMMENDATIONS

This pilot study has indicated the usefulness of the Audience Response Machine for continuous measurement of the process of human evaluation of the environment. The use of a video tape for the stimulus has been shown to be a viable model of the perceived environment; it is continuous and it has sound, like the "real world." Other studies done in this area of research have traditionally employed slides, snapshots or artists' renderings of the environment for subject stimuli. In addition, these same studies use a questionnaire for their recording of subject responses. It is clear that the use of an A.R.M. and a video tape stimulus played over a T.V. monitor is much closer to getting at the actual continuous and process notion of environmental evaluation.

Within the body of this study there were some interesting findings which shed light on the evaluation process. Two categories of environmental evaluation were indicated. To be able to pick out differences in categories of evaluation is a good step toward understanding how it is that people evaluate. It begins to give us an indication of what kinds of questions we should ask people about their environment when we are engaged in design/planning.

Overall the video tape was rated unfavorably. This could be attributed to a number of aspects of the tape. The fact that the tape was in black and white and thus not as "realistic" as color could have affected the responses. A black and white stimulus does not portray the color dimension which is important to landscape scenes. The audio dimension of the tape was predominated by vehicular sounds; this was not appealing to the respondents. It is also possible that, in general, the content of the pans was predominated by negatively valued scenes. All of these issues need further exploration in future studies. A color video tape with dubbed in sounds should be implemented to give additional insight into the evaluation process.

This study indicated that there is more variability in male ability to recall environmental stimuli, than there is in female. This may be evidence that females and males have different recall "styles;" women appear to be more conforming and rigorous, men more erratic.

Also evidenced in the study was the difference between the ability of freshman to recall over upperclassmen. Again, perhaps the older group is looking at a different set of variables in the stimuli than are the younger people and the recall test only addressed the components of the younger group's evaluation system.

The outcome of the Chi Square Test on table 8 indicates there are no apparent differences in the table cells. It could be that this is indicative of two separate and independent variables, i.e., the process of evaluation of stimuli is different from that of recall. Perhaps a correlation analysis should be done to unearth more information. It is interesting to entertain the notion that peoples' immediate feelings towards environmental stimuli (measured by the A.R.M.) may not have an effect upon what they are able to remember about the stimuli. This may add fuel to the philosophical argument that peoples' attitudes do not necessarily reflect their subsequent behaviors. This too, is an important aspect of human evaluation which designers/planners can utilize in their work.

The item analysis of the questionnaire indicated that there was a select group of subjects who were more attentive to the audio dimension of the stimulus. These respondents were also the lowest scorers on the Recall test. This indicates that the audio dimension of stimuli is attended to more by certain individuals or that certain sounds attract some peoples' attention more than others.

This study has been a first step in exploring a valuable potential method of measuring the complex process of human evaluation. Many new and interesting unanswered questions wait for investigation by those who feel the urgent need to come to grips with the gap that still lies between the public, the environment and the designer/planner.

APPENDIX

CONTENT OF VIDEO TAPE PANS

PAN 1 & 2: The Scioto River at Griggs Resevoir (Route 33; Columbus, OH) - These pans total a 360-degree view of a predominately pedestrian oriented parkway along a river. The first pan shows views of the water and the opposite shore. Pan 2 shows wooded hillside with picnic tables and play equipment. The audio includes vehicular, human and bird sounds.

PANS 3 & 4: Upper Arlington Shopping Mallway (Arlington Avenue; Upper Arlington, OH) - These two pans were of a two-block shopping area along one side of Arlington Avenue. The buildings are uniformly 1930's English Tudor in architectural style and represent a cohesive and attractive commercial corridor. The pans were split between the two blocks. There are the sounds of automobiles.

PAN 5: Shopping Center Parking Lot (Henderson Road; Upper Arlington, OH) - This pan is representative of the genre of typical supermarket/convenience-stores complexes that could be seen anywhere in America. The pan is monopolized by the presence of automobiles, power lines, pavement, and low line commercial buildings in the distance. The auditory dimension is consumed by the automobiles.

PAN 6: Ohio State University Golf Course and The City of Upper Arlington Municipal Building (Tremond Road; Upper Arlington, OH) - This pan shows the green, lush golf course framed by large canopy trees; the architecturally dynamic municipal building and its gracious lawn; and the three-way road intersection between the golf course and the municipal building. This pan also has the automobiles and the sounds of birds in its auditory dimension.

PAN 7: Campus Area - Seva Restaurant and Northwood School (High Street & Northwood Street; Columbus, OH) - This is a view of an intersection in the campus area of Columbus. There are a lot of "student ghetto" houses, parked and moving cars, pedestrians on the street, traffic lights, signs, and so on. The two dominant structures are the Seva Restaurant and the Northwood School, which are also old and dishevelled in character. The sound of automobiles is dominant in the audio dimension.

PAN 8: Goodale Park (Goodale Road: Columbus, OH) - This is a view of a downtown park which is in the English Landscape style. The park is somewhat overgrown and poorly maintained but yet remains gracious. There are the sounds of people, automobiles and birds.

PAN 9: Government Buildings (Gay and Town Streets; Columbus, OH) - This is a downtown, urban municipal scene. The pan is predominated by large, formal architectural styles, with formally landscaped lawns and walkways. Also of dominance in the audio are the automobiles, the traffic systems and the urban noise.

PAN 10: German Village (Fifth Street; Columbus, OH) - This pan is of a historic district in downtown Columbus. Most of the homes in the pan have been restored to their original character and offer a pleasing architectural impression. The streets are cobble stone. It is quiet except for an individual car stopping at a corner.

PAN 11: Fancyberg Park (Kioka Road; Upper Arlington, OH) - Fancyberg is in a suburban neighborhood where there are nice middle class homes, large lawns and a lot of open vistas. This pan is a view of a portion of this neighborhood and a look at the long vista across a very open park. The audio dimension is peaceful with the sound of chirping birds, a distant train.

PAN 12: "Five Point" (The Intersection of Fishinger, Tremont, Kenney & Northwest Blvd.; Upper Arlington, OH) - This final pan is another "typical American scene" of a heavily congested vehicular intersection with all the cars, light poles, and gas stations on every corner, that one would expect to see. The sound is very vehicular.

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Human Habitat at the Fringe of the Forest: The Character of the Place[1]

Richard L. Meier [2]

William Ewald [3]

INTRODUCTION

The fringe of the forest is like the edge of the sea -- an interface between lifeways. The sea is more robust by far than the forest, however, and therefore more impervious to insult.

Edges attract the eye; they frame the image; they challenge the imagination. On one side of the boundary lie the shadowy depths, on the other a morphology easily converted to human scale. Individuals seeking places in these ecotones are generally non-conformers.

The edge-of-the-biome is usually more dangerous. Predators may come from both directions; natural hazards likewise. Any number of forces may cause the boundary to shift, thus stranding anyone rooted to a site. The human dwellings that fit the forest boundary zone best must nowadays be more secure than any peasant cottage appearing in Grimm's Fairy Tales. People live much longer now, and they have more demanding expectations than mere survival. If there is to be a greater investment in personal security, the structures must also last much longer -- they must withstand a wider range of threats.

We introduce here some of the major features of the new thinking about the design of dwellings in human settlement on the fringes of the forest. If people feel the need to be there, what are the most reasonable ways to live?

FORCES AFFECTING CHANGE

Since World War II human settlements have been invading the beaches, the deserts, the forests, and even the chaparral, partly as a result of campaigns to save well-drained fields and orchards. Former suburbanites, having learned early how to live much of their life on wheels while otherwise occupying a landscaped plot, very often seek to buy more space (fig. 1). They wish to put their backs to the wilderness and defend

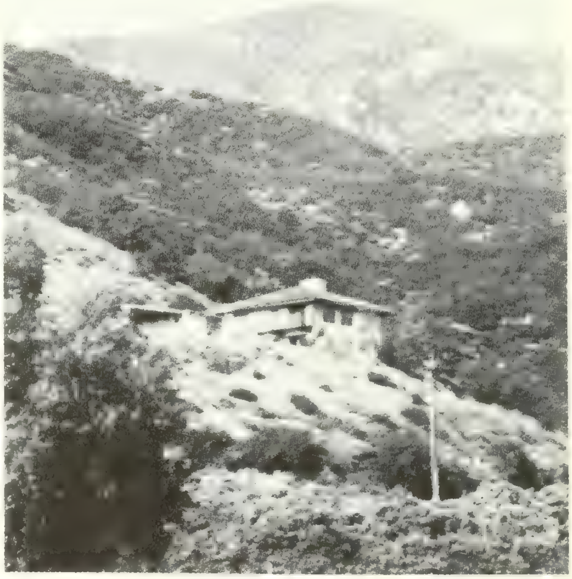

Figure 1--Habitat at the fringe of the forest, perched high in canyon chaparral.

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[1] Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2] Professor of Environmental Design, College of Environmental Design, University of California, Berkeley.

[3] Planner and Designer, President of ACCESS, Inc., Santa Barbara, California.

their privacy in front by building on back lanes or introducing discreet green cover. In order to "get away from it all" they expect to spend only a little more time and fuel than before. Along the open coast line regulation has frustrated these would-be settlers; the vulnerability of the desert to assault by wheeled vehicles is expected to halt the infiltration there very soon. That puts extra heavy migration pressure upon the chaparral and the forest. [4]

Simultaneously we see that hydrocarbons are on their way to becoming scarce. Gasoline and low pressure gas are expected to be in dwindling supply and probably rationed well before the latest mortgages are paid. If people were guided by purely economic considerations, the population on the fringe should thin out and the pressure on it would be relieved. However, it seems more likely that the flow of refugees from the suburbs will swell in volume, and those that arrive will establish themselves more solidly, living less of the time on wheels. The high value they put upon being at the edge, residing within sight, sound, and smell of the brush, and within viewing distance of the trees, makes them appear unreasonable. Yet they insist upon spending their life savings and personal attention on these out-of-the-way sites, while fuel scarcity is a problem they see easily resolved by drawing upon the resource at their back (fig. 2).

Many of the settlers are fearful of street crime in the cities, so they will accept other, more natural, risks instead -- the most serious of which is fire. When effective provisions are made to stop the fires, we all have learned that the fuel accumulates on the land. Then, when environmental conditions are most suited to ignition, a very serious fire results, possibly even a firestorm. [5] The new post-war wave of settlers is responsible for stricter fire prevention, and therefore for the buildup of the threat. Insurance companies seem to be more worried than the residents themselves -- except in those places which have already experienced fire losses.

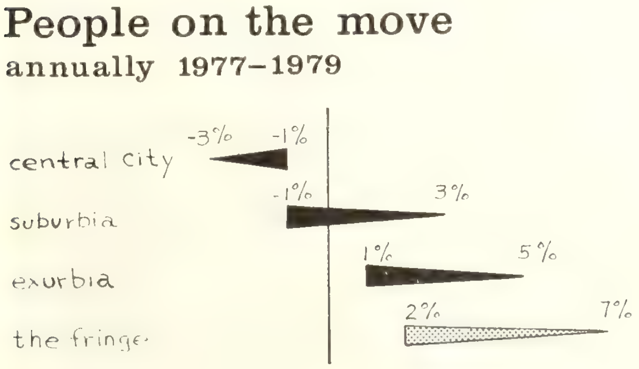

Figure 2--Whether the general trend away from central city continues at current rates or not, many more people will be moving to fringe areas.

Regulation of both building materials and native brush is the first line of defense from wildfire at the fringe. The table shows the benefits of regulation applied to a chaparral canyon if site conditions there were similar to those that pertained before Santa Barbara's horrendous 1977 wildfire in Sycamore Canyon. [6]

SIMULATION SUMMARY	Total Houses	Houses Burned	%
Sycamore Canyon Conditions	287	115	40
Roofs Fireproofed or Brush Cleared	287	55	19
Roofs Fireproofed and Brush Cleared	287	2	1

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[4] In the first half of this decade net migration to the empty areas of the United States was greatest for places known for their recreation and retirement amenities. In the edge-of-the-forest category only the Southern Piedmont Region and the Cotton Belt failed to show a complete turnaround in population flow. The most impressive movements are directed to California-Oregon, Michigan's upper peninsula, upper Florida, and the Intermountain Region from the Rocky Mountain range to the West. K.F. McCarthy and P.A. Morrison, "The Changing Demographic and Economic Structure of Non-Metropolitan Areas in the United States," Rand Corp. R-2399-EDA, Santa Monica, Jan. 1979.

[5] USDA Forest Service, Symposium on the Environmental Consequences of Fire and Fire Management in Mediterranean Ecosystems, Palo Alto, August 1977, General Technical Report WO-3, U.S. Department of Agriculture, Washington, 1977. See especially the contributions of Zivnuska, Biswell, Green, Lee, Taylor, Omi, and Philips.

[6] Prepared for a series of animated color computer simulations by the ACCESS Project in Santa Barbara. Three graphic simulations were run based on 1) the Forest Service's FIRESCOPE program, 2) ACCESS estimate of Sycamore Canyon (an unusual extent of shakeroof houses), and 3) another Santa Barbara canyon. The two prime variables, roof type and brush clearance, were taken from an analysis of the 1961 Bel Air fire Decision Analysis of Fire Protection Strategy for

Another important growing influence often remains unnoticed -- the ever more economical capacity for telecommunication, computation, remote sensing, and automatic control. The most valuable land, urban or rural, is the hilltop or peak best suited to micro-wave relay installations. "Smart" instruments can now be put out to sense a threat, whether fire, flood, or earthquake, and the whole population at risk can be alerted in time. Therefore a disaster will destroy property much more than it causes loss of life; this shift will continue into the future.

The communications-computing revolution now under way is responsible for one other rising trend. A greater variety of professional-type urban jobs can be carried out in fringe-of-the-forest sites. It is easier to get to an airport or a freeway twice a week than to commute regularly, and a handy computer terminal attached to a telephone costs much less than operating a second car.[7] People then have time to make community ties face-to-face, and keep them up via the telephone. As this immigration accumulates, many more people are finding it possible to make a living as jack-of-all-trades or jill-of-all-jobs, operating and maintaining the equipment on this frontier.

THE NEW CONSTITUENCY AND ITS NEEDS

Any civil servant will recognize that we are identifying a new vested interest in the forest landscape (fig. 3). It has already become more important, in the American West at least, than the traditional forest-based constituencies: (1) the lumber and paper communities, (2) the tourist-serving entrepreneurs, or (3) the pilgrims to forest shrines registering as day visitors.

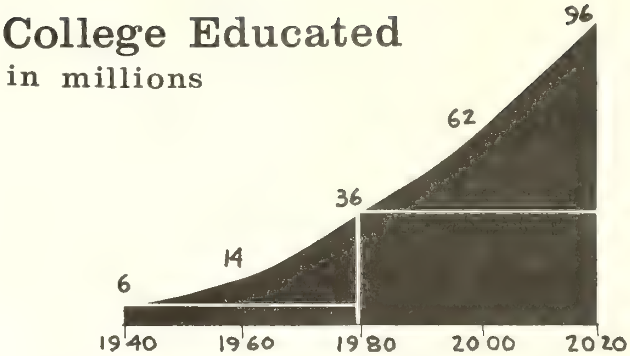

Figure 3--Large increases in college educated persons of all ages in the United States are a primary force increasing population pressure on the fringe.

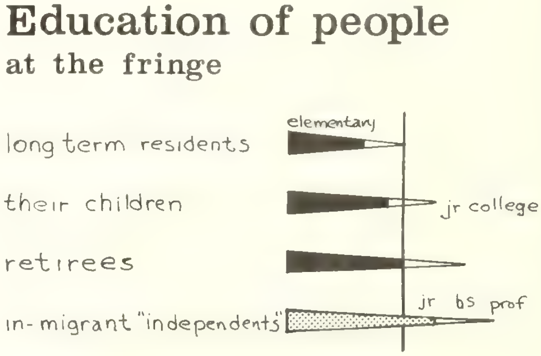

Figure 4--People moving to the fringe areas have had more college education than original settlers at the fringe. They bring with them new types of "independent" living.

The new population is attracted to the fringe by its quiet, its greenness, and its privacy. Its members are educated and they know how to organize (fig. 4) Their networks of contacts are more regional than local. Although the choice of locale in which to resettle is heavily influenced by its external appearance, these values are soon displaced to something people often refer to as the character of a place. Cultural meanings are attached to the landscape based upon its history, uses in daily activities, and the backdrop for special occasions of significance to the communities, such as the deer hunt or a Pioneer Day.

Being literate and well-connected, the new settlers will refer their problems back to their city contacts. They go to the media more often than they go to their Congressman. They will write an increasing volume of letters-to-the-

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the Santa Monica Mountains: An Initial Assessment, prepared by Stanford Research Institute for Forest Service, U.S. Department of Agriculture, Pacific Southwest Forest and Range Experiment Station, Berkeley, California, 1973.

[7] It appears now that documents-manipulating occupations, such as insurance, can be almost fully disconnected from the Central Business District of R. Johansen, R. De Grasse, T. Wilson, Group Communication through Computers, Institute for the Future, Menlo Park, California, Feb. 1978.

editor which attempt to generalize upon local complaints. They are led by spokesmen with an astonishing range of competences, manual as well as intellectual. At present we can gauge much too little about the kind of consensus they are likely to achieve regarding what is essential to "character." What are these new meanings now being introduced into the landscape (fig.5)? We will have to listen closely to the specialists in popular expression and the artists among them -- the novelists, journalists, advertising copywriters, camera masters, poets, composers, dancers, athletes, animal breeders, landscapers, historians, and others.

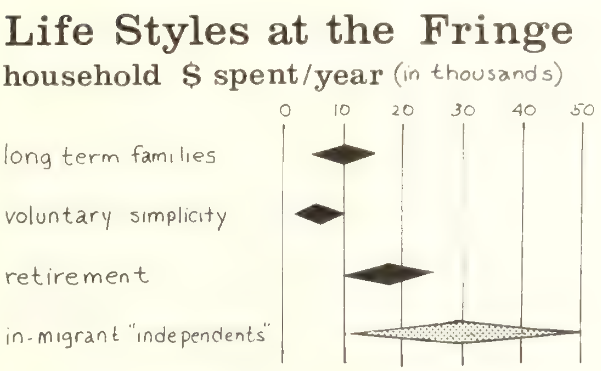

Figure 5--The new mix of life styles at the fringe will undoubtedly affect the politics and the character of the place.

Which of their concerns become items on the agenda of old and new organizations? Listening is the only way that the planners for the forests can learn, so they can be ready to act before situations explode or disaster strikes. The new publics, the bodies of appreciators of things to be preserved, and the subscribers to campaigns are expected to be quite different from elsewhere. Their images of what the forest landscape should be like are likely to come out on top.

FORCES FOR CONSERVATION

Between now and 1990 the Department of Energy is counting upon the forests for the principal "solar contribution" to the energy budget. The half of the tree that has not been harvested has become too valuable to leave behind. Because the salvaged biomass will follow the paths of the logs at least part of the way to the market, it will use personnel already living in communities based upon wood technology, thus extending somewhat the range of their activities. The immediate effect upon the forest landscape should be small. In the long run the interior of the forest may become more parklike, but the change will probably be too gradual to notice.

But the salvage of waste is only the beginning. A demand for energy plantations will arise to deal with longer run problems. A current study in California suggests that the chaparral and marginal forest can be harvested, chipped, and converted into a variety of solid fuels with a harvest cycle of 8-12 years (fig. 6). Should it be allowed to grow back as is, be replaced by more valuable species, transferred to guayule or euphorbia to produce high-valued hydrocarbons, or held in reserve until conditions become more desperate?[8] The new people at the fringe of the forest will have a strong influence upon the decision, and it appears that they will assert themselves on the basis of what they expect will happen to the "character" of their environment.

The other practical use of solar energy is domestic. Passive solar designs, based upon heat storage inside the house and flow controls at the windows, will be economic for heating,

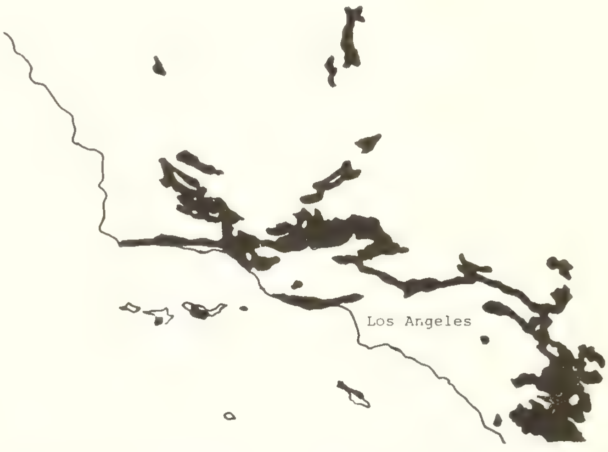

Figure 6--Ecological redesign at the fringe on a regional scale, yielding new energy fuels, could occur around 1990 in areas such as the chaparral country of Southern California (shown in black on the Kuchler 1977 vegetation map).

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[8] Bart Lucarelli, "The Energy Potential of California's Biomass Resources: 1976-2001," Ph.D. Dissertation, Expected Completion Date Dec. 1979.

and sometimes for cooling also. Wood stoves will be depended upon for back up heating for the dismal, cloudy periods of mid-winter. Obviously the forest should not overshadow the energy-collecting windows. So the fringe of the forest is trimmed to fit the needs of dwellings.

People who are "solarizing," or building anew in the solar way, must play games against the weather. Even today one can manage a **standard house and save up to 50% of the energy required for heating, hot water, and food preparation, if the game is played smartly.**

At this point a revelation occurs -- a house with 3-10 feet of soil over it will allow a 70-90% savings. Space **does** not cost energy in an earth-sheltered house[7] Those people who go this way for security against disaster -- to avoid the costs of fire when living at the edge of the forest, the threat of tornados when living on the plains, and of hurricanes when near the shoreline -- can vouch for the ease with which comfort and convenience can be sustained with these extraordinary economies (fig. 7).

These high levels of conservation in the dwelling itself, matched by the need to economize on liquid fuels for transport, will put continuing strains upon the consensus about the desired character of the environment at the fringe of the forest. Very likely the communities will be demanding that quite different things be done for the visual character of the forest as they learn more about the possibilities.

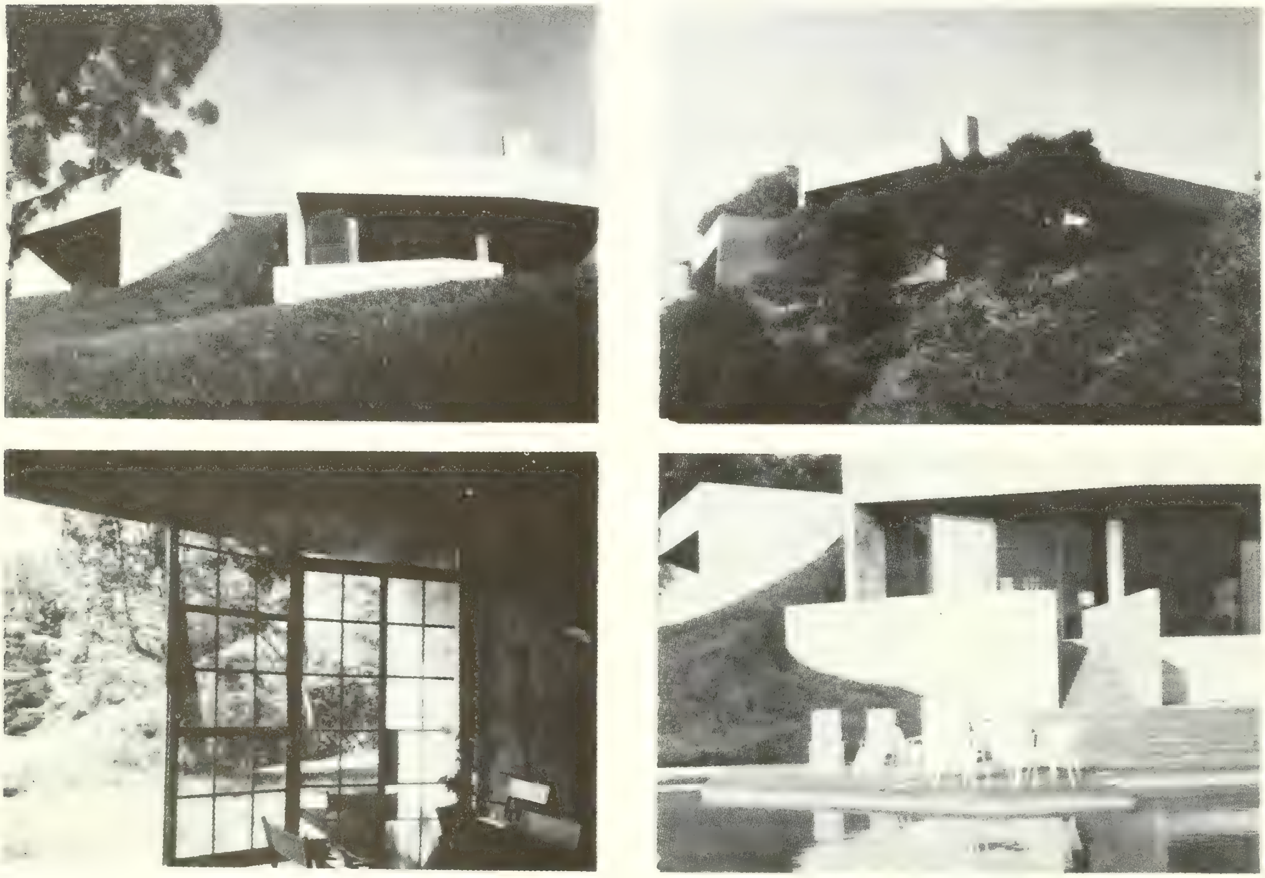

Figure 7--Earth-sheltered habitats are fireproof, conserve energy and blend into the landscape. Photographs show perhaps the most elegant one to date, the Alexander House by architect Roland Coate, built into a Montecity, California, foothill.

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[7] Underground Space Center, Earth-Sheltered Housing Design, University of Minnesota and Van Nostrand Reinhold, New York, 1978.

CONCLUSION

The kind of regulation introduced in coastal planning, with its emphasis upon ecological preservation, viewsheds, and day visitors, is inappropriate for the fringe of the forest, despite the ecological similarities. A new kind of human population is occupying this zone, and feelings about the visual character of locales in the face of the demands for the salvage of wood waste, the need for energy conservation, and national planning for energy self-sufficiency with the aid of energy farms in the most accessible (therefore the most easily settled) regions, will probably determine which program will be undertaken. Add to this the observation that the new interest group determining the image of the forest will possess high competence in the various media, and will be well-connected with State and Federal political institutions.

The forest planner and manager is best advised to listen for the themes of the artists, specialists-in-expression, and propagandists which are picked up by organizations in the communities and can be amplified through the media. Their selection of imagery for treating underground construction solutions and planting alternatives should be closely watched.

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Research Needs for Our National Landscapes[1]

Elwood L. Shafer[2]

Abstract: The prevailing research problem for our national landscapes is: How shall we organize, control, and coordinate public and private development so as to protect, maintain, improve, and manage those landscape features that we value most? Research questions discussed include: environmental/political conflicts, taxation and zoning, landscape classification, public involvement, emerging technology, information and education techniques, landscape benefits, measurement of landscape demand and supply, and systems analysis approaches for comparing the social, economic, ecologic and physical measurements of natural landscapes.

INTRODUCTION

When Daniel Boone goes by, at night
The phantom deer arise
And all lost, wild America
Is burning in their eyes

Stephen Vincent Benét

At exactly 5:13 a.m., the 18th of April, 1906 a cow was standing in a field in the Old Shafter Ranch in California, minding her own business. Suddenly, the earth shook, the skies trembled, and when it was over, there was nothing showing of the cow above ground but a bit of her tail sticking up. Faced by a somewhat similar set of complacent circumstances, we need to develop--through additional research--the methodology and information necessary to understand, guide, and manage the great forces of change that influence the beauty of our national landscapes, or we may find some of them, like the Shafter cow, swallowed up some morning by vast upheavals of our skyrocketing technology.

Before we can specify what research is needed, we need to assess the situation briefly in the near, and even the distant, future.

SITUATION ASSESSMENT

Consider the following Environmental Protection Agency (EPA) projections for the next 21 years for a moment. EPA's educated guess is that population and market demands between now and the year 2000 will call for the duplication of everything that has been built in the history of the United States. For example:

- Urban sprawl may eat up 19.7 million acres of potential recreation land by the year 2000. (That's an area equivalent to the states of New Hampshire, Vermont, Massachusetts, and Rhode Island).
- Another 3.5 million acres may be paved over for highways and airports.
- Five million acres of potential hunting and scenic areas may be removed from agriculture for public facilities, second home developments, and waste control projects.
- And, another 2 million acres of right-of-way may be required for 200,000 additional miles of power lines.

At stake are the nation's irreplaceable estuaries, wetlands, beaches, flood plains, river and lake fronts, farms, forests, and scenic uplands --landscape resources that are paramount ingredients of a healthy, vigorous, democratically-oriented society.

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Why is economic growth destroying many of our landscapes? And, why must the growth be so chaotic and destructive to the landscape's natural beauty? The answer is deceptively simple: the states have delegated their authority to supervise land use to 78,000 units of local government. These local units support themselves mainly by taxing land. As a consequence, local governments are constantly searching for opportunities to develop the land, increase its assessed value, and make it produce more in taxes. Thus, the basic fact of private land development in the United States today is that some of the very units of government that are charged with controlling land use may be the ones most susceptible to pressures not to control it. A critical research question, then, is how to maintain the democratic ideal of local government and at the same time preserve the limited natural environments around towns, cities, and municipalities.

We are in a period of great ferment when citizens' groups, the courts, a number of state governments, the national administration, and congressional committees have begun to consider fundamental reforms in the way state and local governments control visual resources. At the heart of the ferment is recognition that land use decisions affect the visual sensitivities of people beyond local boundaries and that these decisions must be controlled by the states if critical environments are to be protected, and if development (needed by a region) is not blocked by local governments.

At the same time, it is imperative that land use planning to maintain landscape quality should not impede private economic growth. In most instances, laws aimed at protecting the ecology and beauty of natural landscapes can actually help responsible private development by assuring that the State's natural environment won't be paved over by urban-sprawl. Private investors are usually willing to spend the time and money legally required to protect the natural environment when they know the long term profit will be there.

For centuries, Americans have drawn strength and inspiration from the beauty of our country. It would be a neglectful generation indeed, indifferent alike to the judgment of history and command of principle, which failed to preserve and extend such a heritage for its descendants.

Yet the demands of an expanding urban population on a fixed land base is threatening to destroy in a few decades what has been cherished and protected for generations. Residential development in suburbs is swallowing up vast amounts of natural beauty to meet the need for living space. Streams are piped and channeled; trees and meadows are bulldozed. Great swaths of land equivalent to a 50-acre park are obliterated for every mile of expressway. Ironically, many people move out from the city to get closer to nature, only to find that the once-pastoral landscape has been altered and disfigured beyond recognition.

Millions of people are compelled to live in cities without contact with natural surroundings. And, as rising energy costs force more people to live closer to their places of work, we can expect more people to seek residence in central cities. The opportunities for exposure to parks, trees, and outdoor playspace will become even more restrictive unless we take deliberate action.

THE FUTURE

If we were asked to try to capture in a single picture the complex challenges of landscape management that face us in the distant future, we might well consider as our background a vast chessboard that stretches to the far corners of the country. On one side of the board, we might place a white knight--representing the land-use planner, landscape architect, or similar professional faced with landscape management problems and challenges. Opposite the knight, on the other side of the board, we would place an enigmatic, little black box--called technology. In its calm inscrutability, it seems to have crept out of the world of the future. And perhaps it has. Studying the moves of these two pieces, we see that the confrontation between these two "pieces" will occur over a wide range of landscapes represented by the thousands of squares on the board; and instinctively one feels that whatever move the knight makes now, it will be the little black box that makes the last one.

Let's examine briefly some of the events that may affect the moves on our chessboard in the decades ahead. The Delphi Technique, which relys on the opinions of a panel of experts, was the method used to obtain the forecasted information (Shafer et al.1977). By 1980, economic incentives may be offered to private landowners who manage for fish and wildlife. By 1985, these incentives may be broadened to include tax incentives for providing scenic amenities. The Federal role in coordinating natural resource planning may expand from establishing the first land, water, and air use plan in 1990, to a national land use zoning policy by 2000. By 2000, environmental planning may be effectively coordinated between all levels of government and private enterprise. Also by 2000, land use patterns may stabilize--land preempted for one use being replaced with comparable land. All natural resources, including marine and estuarine areas, may be under intensive management.

Biostructural designs may emerge in the distant future as the strongest single force in the landscape architect's repertory. Biological forms and systems provide an untapped reservoir of ideas for the design of environments that can meet man's needs but that emulate the beauty of nature. For example, solar collectors on the crest of a ridge conceivably could funnel sunlight (and thus the necessary energy source) through ducts into the interior of a megastructure of a mountain that would house a whole complex of human activites--ranging from non-polluting industrial industries to high density residential areas. The exterior of the "building" may closely resemble a terraced hillside.

Structures that grow--that is, or biostructures of all types--offer a vast field for landscape management inventiveness. Structures might be created out of green plants. Living enclosures could be shaped by nets, careful pruning, judicious use of nutrients, and so forth. With greater understanding of plant growth processes, it might even be possible to develop varieties of plants that would develop naturally into functional enclosures.

Imaginary natural beauty may be possible. People may be able to switch natural environments on and off by creating perceptually real, three-dimensional holographic environments in open spaces. People could walk through the components of the perceived environment as if they were mirages.

Another possibility for enjoying the beauty of natural environments may be possible by creating interference patterns among laser-projected images of nature's elements and then solidifying the shapes by introducing a polymerized plastic. In effect, the "mirage" or image would solidify into tangible reality.

Stretching this concept to its limits, some futurists would have people visualize various forms and shapes in nature and record--in an as yet unknown way--the distinctive brain wave patterns that the thoughts produced. The patterns could then be converted to sound waves which, when projected through directional antennas, form imaginary structures of environmental components.

Still other landscapes of the future may be possible by covering all surfaces of a room with television screens, thus creating infinite possibilities for bringing natural landscapes into the enclosure. In conjunction with video cameras and recording equipment, a person could live in a total video, natural environment. With computer access and a video synthesizer, an individual could play a keyboard and invent visual effects beyond imagination--or call up scen (the Grand Canyon, Yosemite, or any natural beauty spot he desired). By attaching the system to biofeedback devices, one could visually experience his own biological fluctuations. A prototype example of this phenomenon already exists in Disney World.

On a somewhat more mundane level, computers ca design almost any kind of arrangement of natural components--grow forests, cut them, arrange roads harvest them, or select the most scenic vista avai able in an endless array of vistas. At a more intimate level, the computer could be programmed t human moods by varying the color, light, sound, sh and size of three-dimensional television scenes of natural environments.

RESEARCH NEEDS

And so what does this discussion of present an future natural environments mean in terms of resea The research problem that prevails is: How shall organize, control, and coordinate public and priva development so as to protect, maintain, and improv those landscape features that we value most? Such research should involve the biological, cultural, esthetic characteristics of our national landscap

New information and technology is obviously required to produce new ideas and approaches for enhancing the beauty of America, and its scope shoul not be restricted to Federal action. Research sho look for ways to help and encourage state and loca governments, institutions, and private citizens in their own efforts as well.

Some broad questions requiring answers are:

- In the area of environmental/political conflicts what kind of quasi-public structure would best meet the needs for effective land use and reclamation for landscape values, as well as other needs of society?
- What equitable and effective kinds of taxation and zoning would best support a landscape protection or maintenance policy that will meet the needs of the community while preserving the integrity of the environment
- What kinds of positive action should be taken by individual states to remove certai landscapes from the commodity market?
- What kinds of landscape classification meth best meet the needs of resource planners an managers?
- What means of public involvement work best developing landscape protection and management policies?

- In what areas is compromise most acceptable in conflicts between landscape quality and other social needs? That is, how can landscape values and needs be integrated with other land use goals?

- What kinds of new technologies are emerging throughout the scientific world that will cause or help solve landscape planning and management problems?

- What kinds of information and education techniques can be used to make the landscape meaningful ecologically--so the viewer is informed of the dynamics of its formation and how we need to depend on it for survival.

Underlying these broad questions are more specific challenges, such as:

- What are the best ways to transfer relevant technology to management

- What methods can be used to understand demands and the associated underlying benefits and values of our national landscape better?

- What procedures can be used to inventory, maintain, protect, and augment the supply of landscape environments?

- How can we design recreational facilities that blend harmoniously with the natural environment?

- How can we coordinate landscape beauty supply-demand relationships with other resource uses?

- How can we use a systems analysis approach to interlock the various methodologies described at this conference to develop comparative social, economic, ecologic and physical measures of natural landscapes.

The results of research along these lines will provide us with information to save our Nation's heritage of natural landscapes, it will show us ways to incorporate more of nature's charm and beauty into our urban landscapes, and it will help us to deal not only with man's life space but with man's spirit and dignity as well.

BENEFITS OF RESEARCH

What are the expected benefits of these kinds of research efforts? The benefits of research on natural beauty costs less than might be supposed, because such benefits are linked with many of the most practical ends of our society cherishes.

Beauty fosters safety. It dictates the control of flooding and erosion, and the landscaping and careful planning of, otherwise monotonous, highways to avoid fatigue and accident. Beauty is a component of mental well-being. It provides creative and wholesome outlets for the leisure society. Beauty is associated with economic efficiency; the soot and sewage that make for ugliness also make for wasteful expenditure in cleaning; smogs cause illness as well as displeasure.

Beauty can be a weapon in the fight against poverty, because an attractive community and countryside attract new enterprises, gifted people, and income from tourism. Beauty contributes to the real national income, for a person can derive great satisfaction from psychic relief and renewed spirit by seeing a mountain or from strolling in a fine city square. This psychic income, even though statisticians do not know how to quantify it, contributes to that person's welfare, and to the welfare of the nation.

Finally, living and working in beautiful surroundings is an objective which justifies itself. It was Thomas Jefferson who first observed that communities "should be planned with an eye to the effect made upon the human spirit by being continuously surrounded with a maximum of beauty." Beauty helps to make life and work worthwhile. And this very fact makes natural beauty immensely practical, for a citizenry that is nurtured by an inspiring environment will gain a heightened sense that its life is meaningful and ennobling.

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The Energy Crisis and the American Landscape[1]

Stuart Udall[2]

I might well have been in the audience as a participant had I not gone back into the law because a few years ago, for about five years after I left the President's Cabinet, I called myself an Environmental Planner, whatever that was. I had no credentials except experience and I can say to you it was one of the most satisfying things that I have ever done. I was thinking too, I believe it was Oscar Chapman who was President Truman's Secretary of the Interior who told me not long after President Kennedy had nominated me to be Secretary of Interior, he said, "Stuart there's one thing about that job. If you do your job right, when you finish, there are visible things that you can point to all your life." I think that's true of your profession. That is true of work that many of you are engaged in. Your work is left as a visible mark on the land and, if it's done right, it may be there a hundred, or who knows, a thousand years from now. I was asking myself as I came in yesterday and looked at the literature concerning this conference, how it happened. I want to commend the leaders. I asked myself, would it, five years ago, have been possible for a conference of this kind to be held on the national landscape with a primary focus on the visual resource? Ten years ago it would have been unthinkable and twenty years ago incredible. So I come to you today as an Environmental Planner of your type who took early retirement. I went back to law.

I did not come directly from Washington. I have been spending the last week in Utah and Nevada. I have been taking a crash course in low level ionizing radiation and have spent almost all of my time representing the people down wind from the Nevada bomb test in the 50's who got clobbered. That's a very tragic, demanding assignment and very interesting in fact. A great thing about my life is that I have, as the old saying goes, "lived more lives than one" and at 59, I don't know what's ahead of me, but I'm having a good time. I want you to know that.

I also have a need of a landscape architect if there are any of you in Washington who have some free time. I want you to know what I'm doing with my own life, because I'd like to focus this morning on the big picture and big decisions but we're also talking about small decisions aren't we? About redoing peoples' homes as one way to cope with the energy crisis. On the East Coast we are the people that get all of this oil from Middle East. We're dependent on that life line so I wondered, could one be decoupled from it? I live along and look down into the Potamac in McLean, Virginia where there are marvelous big trees. We converted back to wood stoves which was an interesting experience, but I have a problem right now. A big red Oak fell and I had it cut up, and I'm in the process of spliting it and stacking it for about two years wood for our house. I am left with the stump and the roots and I have a neighbor who is an architect and he's very fussy and I keep telling him, "well I'm going to landscape it and when you look out of your house it will look like a Henry Moore piece of sculpture." I haven't accomplished that yet and I may need some help, but I'm telling you that to let you know that I'm still part of the brigade trying to do my own little thing in my own back yard.

I thought it would interest you today to do a little quick tour of the horizon, to look at where we come from and then where we are headed from one man's view. Very opinionated of course--take it or leave it.

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One of the most interesting things to me about this crowd is how many young people there are, how many of you who in the last ten years have graduated from the universities and gone out and found places in this new and growing profession. The growth has been incredible, hasn't it? And isn't it a delicious irony, I just chuckle inside every time I thing of it, that if the Strip Mine Act, stays on the books, that five or ten years from now the largest employer of landscape architects in the United States will be the coal industry. Isn't that something when you look at our past history. I remember Lawrence Halprin telling me that, when he began his career thirty years ago as a Landscape Architect, what Landscape Architects did was do gardens in people's yards. You know where his own career has lead and where some of your careers have lead or are leading. This is part of the change that has occurred.

It's interesting that one of the things that we have done, is that there has been a very strong process of maturing. I think the values of this country are different in part because of this. Because of the evolution of thought. I remember that when a President decides to leave office he concentrates on his own contribution to history and President Johnson had very strong feelings like that anyway. He knew he had his library and in the last weeks of his presidency he had all of us in and he taped interviews with us about what we thought we had done. I remember telling him then, eleven years ago and I feel the same way today, that although we had done significant things with regard to new national policies and land and resources, (Bill Duddleson mentioned some of them, the Wilderness Bill, the Wild and Scenic Rivers Bill, the Historic Preservation Legislation, the Land Conservation Water Fund, things of that kind) where we were really making new policy was with regard to the environment. But I thought the most important thing we had was not these laws. It was a change in awareness, the beginning of the evolution of what we later called ecological thing, the environmental ethic and so on.

Now a lot of you younger people think that the environmental movement began on earth day in 1970. There are even a lot of reporters who think that and maybe they are right. I don't know. I don't read history that way. It's usually more complicated when people are actually included. My own thinking began to change with Rachael Carson's book Silent Spring And I know as time moved on there was a reassessing of values. I thought it was a wonderful moment for the country when Lady Bird Johnson, First Lady of this country and a very wonderful woman in a very sort of straight forward, simple, down to earth way, talked about natural beauty and the values associated with it. That became a theme that was propelled for awhile. In any event, as we moved on into the decade of the 1960s our thinking evolved. I remember a slogan I used to use in my speeches. I had borrowed it from the Sierra club in 1961 and the slogan was "What We Save Now Will Be All That Is Saved"--the idea was that we had a few precious years in which to grab off the finest of our remaining national seashores which is another thing we did in the 1960s. We had a few years for states to make decisions about the best remaining state park options, wild river, scenic rivers, and all the rest. As far as big decisions concerning the land, we felt that we were going to make most of them in the 1960s and I think that was a good judgment. I think it holds up.

But, as our thinking became more sophisticated, as we absorbed the message from Silent Spring, as we realized the number of pollutants that our industries were producing which were permeating out into the system, we began to realize that nothing was saved. Nothing was really saved and the wilderness itself was threatened everyday by these new kinds of pollution that were so subtle. They could be carried from place to place in a most subtle way.

One of the things I am proudest of today was that of the fight against SST. I'm going to make a boast here. The fight against SST really began right under President Johnson's nose in 1966 within the administration. I was allowed, or I got away with it somehow, to challenge whether the SST could ever fly overland in the United States. I appointed the Scientific Advisory Committee, which included people like Barry Commoner, and they came in with the arguments in 1966 or 1967 which killed the SST Program in 1972. I began to ask myself the question in talks with people in my department. Well, if the SST flys overland over the United States with a sixty mile sonic boom carpet, as they called it, where would they fly? Well, they would avoid big cities, middle size cities and small cities. They would head for the places where the fewest people were, and where were the places where the fewest people were? National Forests and National Parks, Wilderness and Wildlife

Refuges would be the sonic boom carpet.

These were the kinds of problems we were dealing with then and I review all this only to make the point that our thinking, our policies, changed gradually. I think that is still what is happening. We often times like to oversimplify things. Certainly out of this came very basic changes in thinking and much of that was embodied in what was probably the most important law of all. It was passed in 1969. That was when some of the work was done. Actually the idea for it was started in 1968 while I was there and it was the National Environmental Policy Act. This was certainly a new beginning. It mandated, Congress didn't understand what it was doing, an incredible thing. I don't think the authors of it really knew its implications and the guy who really deserves the most credit, I think, was Senator Jackson. I'm not sure he fully understood what the impact would be. What that Act said is that from now on the old kind of single-minded planning is out and we are going to plan in a more realistic and balanced way. Just think about what that one principle, as a matter of public policy, said. It also said that some of the values that have been left out of other considerations, some of the human values, some of the agricultural values, and all of the values of natural systems, will be taken into account in this planning process. That was an enormous step forward, although it was done by accident. I think it was a great day and a lot of you wouldn't be here probably today if that act hadn't been passed. Of course what has happened since then is that these new values and planning procedures have become institutionalized. To me, one of the key questions the last few years before the Congress and the country is, are we going to whittle away and repeal the National Environmental Policy Act. At the time of the oil embargo and when OPEC bared its teeth in 1973, a lot of the industry people in the United States thought, "Boy we got them now. We can't afford all this crap about environment and ecology and planning." They thought they had the arguments to say that we have to discard this kind of thinking and these kinds of values. But congress hasn't done that and the more it becomes institutionalized, the more it's built into our law, into our way of thinking, into our way of handling matters in government, the more it becomes something that is a permanent part of American life.

So out of this has come the moment of which you are a part, with your new techniques and your new skills representing these new values. That's what I want to say. We have come a long way to be sure, but what about the next twenty years, where are we going? Where is it leading us? I believe that is the reason I choose the topic that I did, "The Energy Crisis or Energy Crunch in the American Landscape." I feel that we are facing profound changes. I believe your profession is going to be much more upfront even than it has been in the past. I feel this is the time for great opportunity because we are going to have to make some very big and very basic and very structual changes in American life. I thought there was a lovely little metaphor of the present predicament of the American people in the New Yorker Magazine a month or so ago. It showed a couple in what looked like a Japanese import car with ski racks and skis on the top. The woman is saying to the man, "I have a bad conscious. Everything I really like to do involves burning hydrocarbons." Well, that's where we are. We're addicted, and not only to hydrocarbons. Our economic system is built around the extravagant consumption of hydrocarbons. I'm not going to give you my energy speech. I decided not to speak, or speak very little, on energy until the nation is ready to listen. We are not ready to listen. I think most of you probably are, but there will be a time when people in general are ready to listen. Nevertheless, shortage is looming and already nibbling at the edges. But we in this country are unconvinced somehow. I'm amazed everytime I come to California, particularly Southern California, and see the great freeways and the cars moving and this is supposed to be beginning, this is suppose to grow? I know in my bones it's a climax stage and it is going slowly to die and change. The automobile has been such an incredible part of our lives, and our freedom in a way, and has provided a wide range of choice. This is going to change because we are running out of oil and have been for many years now. The world oil shortage, which some of these so called experts where telling us was off in the late 1980s, suddenly popped up when the Shah had his trouble a few months ago and the situation, the crunch, is closer then anyone thought. It is going to mean some very big and basic changes. And most of these changes, I believe, are changes which will involve redesigning America, redesigning our cities, redesigning our landscape, reconsidering much of what we are going to have to do. It certainly will mean an end of the freewheeling, incredibly mobile society that we have. How, when we are rushing pell-mell to be the first major oil-have-not nation in the world, can we in the

United States assume that we can continue having over half the automobiles, traveling well over half the miles that are traveled, using over half the gasoline in the whole world? How much longer can we do it? How much longer can we continue talking about becoming more independent? We are becoming more dependent by having our oil bill go up and so on. That's the big question? The end, or rather the climax, the crunch, is not all that far away. These changes that I mentioned a moment ago will be prolific.

We saw in this wonderful presentation earlier this morning how some areas of our country are already having to reconsider what a good house is or what housing is all about and how it fits into the landscape. The only thought that I had as I watched related to my favorite city, Santa Fe, New Mexico. I thought that the old timers didn't have a bad idea with adobe you know. Maybe we'll get down the road and even concrete won't be as cheap as it is. We may have to use even more earthy materials which they used to use down in Santa Barbara. But what does our future hold?

Are we really going to have all those new highways that we're talking about? Or do we have more now then we'll ever need if we are running out of oil? If we don't need the highways, are we close to the day? What a glorious day that will be and how busy all of you will be. I talked about it for years. In fact, I haven't mentioned this one for awhile. They are going to wake up in Washington and discover that we need to fill in the gaps and make our cities more compact. With gasoline rationing the best way to save energy and to improve the lives and help the people, is to take the highway money, or a big chunk of it, for two or three years and build within each of our cities greenways, places for people to jog, to walk, to bicycle, to use our own energy to go to work. And what does our jogging revolution say? What does this worry about health say? It says that at least 20% of us out there would use our own energy and unhook from the automobile to get to and from work if we were given the opportunity. That is, I believe, just around the corner and what a challenge that will be to landscape architects--to build these new facilities.

But we are still operating on the assumption that we will have fuel. What we are saying to eveybody now is to fly. Everybody fly. I read an article in Las Vegas yesterday where they say "Well the gasoline thing is going to disturb the tourism that is so important to Reno and Las Vegas and maybe the California people are getting nervous they won't come the way they used to. But now we are deregulating airlines so there is going to be a lot of new flights and everbody will fly." Well, the jet fuel comes out of the same barrel of oil gasoline does and if we are going to have a shortage of gasoline then we are going to have a shortage of jet fuel. The United States can't expect that we are going to dominate or consume all the jet fuel in the world. They seem to be saying that we don't need railroads, and let them go on down the tube and that's another problem.

There's a redesigning going on of everything including the houses. The way they fit into the landscape is being reconsidered. Cities are being redesigned to find out what a livable city is and what can be done to make it more livable. We're redesigning our transportation system, reconsidering even our energy systems and wondering if we are going to need all these power lines? Are we going to keep our committment to the big mega-systems? I wonder some days whether we are really going down the wrong path. I read in the Wall Street Journal the other day what's happening. New York, in some ways, is a preview of the future. Some of the industries are decoupling themselves from the electric power system and building their own electric power systems which is completely counter to the whole trend. We very well may find many of the new houses of the future, in certain parts of the country, using wind energy solar energy, and other things. They may become largely self-sufficient and hooked up to their electric power company as a back-up rather than as a primary system. The electric power companies of the past, as we have know them, may primarily be providing commercial power rather than the power for homes at least in some communities and some parts of the country. I don't know where we're headed. I'm not sketching in any road map, blue print or scenario but I see enormous changes-structual changes, changes in design, changes in the landscape. I worry. The only thing worrying me about the present, the very fine presentation here this morning, is that I wonder if were going to have to look at all of our land to grow biomass for energy. You know what kind of environmental problems that presents us with. How are we going to harvest it? How were going to deal with it? We face big, big problems as we leave the period of cheap energy and enter into a period when energy will be very precious and when energy efficiency and conservation become the dominant and paramount ideas and concepts that our society must function under. Then certainly you can see why I believe we are on the edge of a time which is much more challenging. There is more of need for your talents or skills then we even thought a few years ago. So what I'm suggesting also is that with this value revolution that has been implicit in much that we have been involved in, that we may even begin to ask some simple and sensible questions. Wouldn't we be better off and happier as individuals, and as a country, if we were less mobile? Would we care more about our own backyard and our own community instead of wheeling around the way so many Americans like to do these days? One of the great thing that happened to me in the Kennedy years was to form a friendship with Robert Frost, the old poet in his last years. I was reading his biography again and the most creative period of his life was in his thirties. He was living in a little house out at the edge of a little town called Durham, New Hamsphire. He walked to school with his children, to the little school where he taught Little Academy, two miles in and two miles out everyday and by today's standards he was deprived. You know we would say poor man, there he is walking. But I wonder. I always wonder of the poems were created during his most productive period as a poet, how may of the poems did he write on those walks? I haven't read many poems lately of people who wrote them as they were driving in traffic jams or rushing across the country. You know, there is real human satisfaction. Maybe if we slow down and care more about our environment and what we see, and spend more time puttering in our gardens or pruning our trees or getting our firewood or whatever, that we would be a better country and a happier country. At least that is my thought. So I suggest, dream your dreams and plan your sensitive plans. Who knows, they may be needed tomorrow.

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Elsner, Gary H., and Richard C. Smardon, technical coordinators.
1979. **Proceedings of our national landscape: a conference on applied techniques for analysis and management of the visual resource** [Incline Village, Nev., April 23-25, 1979]. Gen. Tech. Rep. PSW-35, 752 p., illus. Pacific Southwest Forest and Range Exp. Stn., Forest Serv., U.S. Dep. Agric., Berkeley, Calif.

These 104 papers were presented at "Our National Landscape: A Conference on Applied Techniques for Analysis and Management of the Visual Resource," Incline Village, Nevada, April 23-25, 1979. Included in this proceedings are state-of-the-art papers on landscape planning. Emphasis is upon planning the visual aspects of the large and wildland areas of the United States. Methodologies presented are useful in many areas of the world. The major thrusts of these papers are to a) describe the current and future challenges to the visual resource; b) describe available technology for solving landscape planning problems; and c) illustrate appropriate combinations of technology and problems. Specifically, papers address these themes: landscape challenges (presented as a series of "simulated visual field trips"); descriptive, quantitative, and psychometric methodologies available to solve landscape problems; available legal and policy tools; combinations of technology for solving problems; landscape management systems; new dimensions of landscape planning; and priorities for research.

Retrieval Terms: landscape management, outdoor recreation, visual resources, research planning, simulation, conferences.

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